FINAL REPORT

INTEGRATED MANAGEMENT PROGRAM IN SUPPORT OF SASKATCHEWAN SEED POTATO INDUSTRY

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March 2000

Prepared by: University of Saskatchewan

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March, 2000

Integrated Management Program in Support of Saskatchewan's Seed Potato Industry

AGRI-FOOD INNOVATION FUND
Horticulture Sector

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Executive Summary

Seed potato acreages in Saskatchewan are increasing in response to the demand for quality seed in both local and export markets. **This collaborative research program between the Saskatchewan Seed Potato Growers Association, the University of Saskatchewan and the Canada-Saskatchewan Irrigation Development Centre had two main objectives;**

a) development and testing of cost-effective agronomic methods to improve yields and quality of seed potatoes of the varieties already in demand in the local and export markets,

b) evaluate the performance and develop agronomic recommendations for newly released cultivars of interest to Saskatchewan's seed and table potato growers.

Objective a. Agronomy of Established Varieties

a) Generation effects - the yield potential of Saskatchewan-grown seed was quite stable when generations ranging from Elite I through to Certified were evaluated. The consistent quality of Saskatchewan seed can be attributed to the skill of local growers in combination with environmental conditions ideally suited to the production of vigorous disease-free seed.

b) Shepody - Seed Type and Plant Populations - comparisons of whole versus equivalent-sized cut seed **indicated consistent yield advantages from planting whole seed**, with no associated change in tuber size distribution. Closer in-row spacings increased yields under irrigation or under dryland when rainfall was abundant. Close planting of whole seed is recommended for this difficult to grow variety.

c) Time of Planting and Seed type Interactions - delaying planting of Ranger Russet or Shepody from May 10 until June 1, **greatly reduced all yield components**. The extent of the planting date response was determined by the relative suitability of growing conditions in the spring and late summer. Planting whole seed substantially enhanced yields. This yield response likely reflects a) superior plant stands with whole seed due to reduction in seedpiece decay and b) greater tuber numbers produced with whole seed. Whole seed tends to produce more mainstems than cut - this in turn promotes tuber set.

d) Seed Handling Methods - in comparisons of the yield potential of Shepody seed exposed to various handling methods (accelerated aging, greensprouting, cutting), the most consistent effect was the poor performance of cut seed taken directly out of cold storage. Greensprouting and aging the seed for 4 weeks at 15C prior to planting enhanced performance relative to the standard.

e) Planting/Harvest Date - for Shepody and Russet Norkotah, the optimal time of planting/harvest was determined by the conditions prevailing during certain key developmental periods. **The optimal regime involved early planting if conditions at planting were adequate to allow for rapid emergence.** Otherwise some delay in planting was desirable. The early planted regime received the warmest temperatures and longest daylengths which promote growth and yields in potatoes. Under dryland conditions it was crucial to avoid timing tuber set and bulking during periods of drought stress. Unfortunately, the timing of rainfall is inherently unpredictable. In regions where stored moisture reserves are significant, early planting may be the best option for dryland production as it makes maximum use of

stored moisture.

f) Seed type/Spacing - Yields and tuber size distribution of Russet Burbank, Atlantic, Shepody and Alp grown from whole, single cut or multiple cut seed were compared in 1996-1998. In 1996, seed type had effect on yields. In 1997 the optimum seed type differed between cultivars tested. Yields increased as t in-row spacing decreased. Overall, the seed-piece form had no effect on yields. However, the different cultivars responded differently to the seed type portions. The highest yields for cv. Alpha were obtained using whole seed. Alpha is a European cultivar selected under conditions where whole seed in the norm. For Atlantics, single cut seed was best while for Shepody and Russet Burbank, planting quarters resulted the highest yields. The increase in yields with cutting of Shepody and Russet Burbank was unexpected a runs contrary to previous findings. Single cut seed pieces produced more mainstems, consequently highe 'seed' grade yields then whole seed. More work is needed to confirm this phenomenon.

g) Irrigation and spacing trials -In the 1997 trials, yields progressively increased as moisture availabilit increased. In 1998, the intermediate moisture regime (40% available moisture) produced the highest yield In 1999 differences in yields between the irrigation regimes were relatively small, due to abundant rainfal **In all three years, yields increased with increasing plant populations.** The optimum seed piece spacin was 20 cm for seed production both under irrigation and dryland. Even in a drier year (e.g. 1997) this plant population did not reduce yields as a result of moisture stress.

h) Carry over effects - time of planting of the seed crop, the type of seed used and the irrigation level provided had little effect on the growth habit or productivity of the resulting progeny.

i) Planting depth effects - Deeper planting up to 30 cm did not affect mainstem density of 'seed' grade tuber yields. It is likely that the soil was sufficiently warm at the 30 cm depth when potatoes are planted during the third week in May. Single cut seed pieces produced more mainstems, consequently higher 'see grade yields then whole seed.

j) Post-emergent hilling: Haulm covering produced higher 'seed' grade yields in some situations but ha little effect in others. More work is needed to clarify this phenomenon.

k) Seed piece spacing uniformity - 'Seed' grade potato yields were highest when the crop was grown under irrigation, at a higher plant population and when seed pieces were spaced uniformly. Highest tuber yields were obtained when the seed pieces were uniformly spaced and this effect was more pronounced under dryland than irrigation. It appears that irrigation was able to compensate for any yield losses resulting from variable seed distribution.

l) Nitrogen, phosphorus, and seed piece spacing effects - Trials conducted on low fertility soils indicated that acceptable yields of most commercially popular cultivars can be obtained with as little as 100 kg/ha total N. Russet Norkotah required more nitrogen than Ranger Russet or Shepody. Shepody responded differently to nitrogen levels in the different seasons. The optimum nitrogen levels were 100 kg N/ha in 1997, 200 kg N/ha in 1998, and 150 kg N/ha in 1998. Shepody consistently produced higher yields at 120 kg P_2O_5/ha applied phosphorus, while 60 kg P_2O_5/ha was sufficient for Ranger Russet and Russet Norkotah. Plant populations had little effect on fertility requirements.

M) Nitrogen source effects - Ammonium sulphate tended to produce higher 'seed' grade yields than urea.

although this effect was variable between years and between cultivars.

N) Nitrogen, timing of application - in trials conducted with 100 - 150 kg/ha of applied nitrogen, the time of fertilizer application (all at planting or split applied, at planting and at hilling) had little effect on the N response.

O) Potassium, source and rate effects - Potassium application produced positive yield responses in one of three test years. There were no clear indications for the differences between potassium chloride and potassium sulphate. High levels of sulphate appeared to cause sulphate toxicity.

Objective b. Agronomy and Management of Newly Released Potato Cultivars

a) NorDonna Agronomy - the trials indicated that this new red table variety is slow maturing but produc yields comparable to the industry standard **if it is provided with adequate time to mature.** Under dryla conditions, in-row spacing had little impact on yields or tuber size distribution. Under irrigation, close in-row spacings increase yields.

b) Agronomics and yield potential of new varieties - Norland and VO498-1 were the highest yielding red-skinned cultivars tested irrespective of harvest date or availability of moisture. NorDonna performed poorly while Cherry Red was intermediate in its yield potential. FV9649-3 produced superior yields to Russet Norkotah and Russet Burbank at 90 days after planting but its final yields were poor relative to th established varieties. Increasing the plant population by reducing the in-row spacing had little effect on yields of any of the varieties when moisture was limiting. When moisture was abundant, yields of all cultivars progressively increased as the in-row spacing narrowed.

c) SSPGA Test lines - five numbered lines presently licenced to the SSPGA were evaluated for evaluate for field performance and quality relative to standard varieties. All varieties tested exhibited merit in som yield or quality parameter. ND2937-3 appeared to merit licencing action.

Impact and Future Directions : The agronomic recommendations generated by this research have been reviewed and accepted by many industry support staff, with progressive adoption of this information by Saskatchewan's potato growers. Useful suggestions as to future directions for this type of research have been provided by the industry. Members of the Saskatchewan Seed Potato Growers Association toured th research plots on numerous occasions and have assisted in evaluating the performance and quality of the new lines. The results of these trials were presented to the growers and industry stakeholders at Annual meetings and as written summaries. On the basis of these trials, ND2937-3 (AC Peregrine Red) and FV9649-6 have been licenced exclusively to the Saskatchewan Seed Potato Growers Association. Efforts to maximize the performance of these new SSPGA lines should continue. Similarly, testing of newly released lines for adaptation to Saskatchewan growing conditions and market requirements is critical to the continuing health of the seed potato sector.

Section 1. AGRONOMICS OF ESTABLISHED VARIETIES

PROJECT BACKGROUND

Seed potato production in North America is concentrated in the Northern States and in Canada due to the perception that the seed potatoes produced in this region are especially vigorous and carry low levels of seed-borne diseases (Slack, 1993). Recent studies conducted by the Department of Horticulture Science, University of Saskatchewan has demonstrated that the superior growth and productivity of potato seed-tubers produced in Saskatchewan compared to seed originating in relatively lower latitudes was due to physiological factors rather than the level of seed-borne diseases. These results gave rise to the concept of 'Northern Vigor' (Wahab, 1993).

Identification of the concept of 'northern vigor' in seed potatoes has significantly increased seed potato production in Saskatchewan and exports to the U.S. The feasibility study conducted for the Prairie Potato Council by Harvest Foods Ltd. (1994) has identified several additional promising off-shore markets for Western Canadian seed potatoes, particularly Mexico.

In most of Europe and Asia planting small, whole seed is the traditional approach, but in North America including Canada, the common practice is to cut seed pieces from large tubers for planting. There are several advantages to using drop-seed compared to cut seed pieces for planting (Schaupmeyer, 1992): (i) Elimination of the costly cutting and seed piece treatment operations, (ii) reduction of the risk of disease spread which can occur during the cutting procedure, (iii) proliferation of Mertect resistant Fusarium can cause extensive seed piece decay even after seed piece treatment following cutting, (iv) drop-seed produces more tubers per plant than cut seed, which is particularly advantageous for seed-tuber production, (v) planting drop seed produces a uniform plant stand by reducing skips, thereby, reducing over-sized tubers, and (vi) in the seed industry, it eliminates the need for planting higher generations seed in tuber units.

One of the primary barriers to planting whole seed is cost. Canada's seed industry has not adjusted their practices to focus on economical production of drop seed.

This project is designed to develop cultural practices to maximize production of high quality small seed-grade tubers in the cultivars popular for domestic and export markets. Tuber size control and tuber set in potato is dependent mainly on cultivars (Iritani and Thornton, 1992), environment and cultural practices such as variation in stem density/spatial arrangement (Allen and Wurr, 1992), irrigation (Harris, 1992), and soil fertility (Gregory and Simmonds, 1992). **The specific objectives are to examine the impact of the following management variables on overall yields and the tuber size distribution;**

a) Whole versus comparable size cut seed

Whole seed typically produces a better stand with more mainstems/unit area than cut seed. As tuber numbers tend to be directly related to mainstem number, planting whole seed may result in a shift in tuber-size distribution towards tubers suited for use as whole seed.

b) Manipulation of Plant Population/Time of Planting.

Many growers use late planting as a means of obtaining the desired small average tuber size needed for seed. Unfortunately, late planting inevitably involves some sacrifice in yield. Yield loss with late planting is particularly severe in indeterminate cultivars such as Russet Burbank. As plant populations increase, average tuber size decreases, while total yields remain relatively static. Therefore, increasing t plant population may represent an attractive alternative to late planting as a means for controlling tuber size. In early maturing varieties like Norland, the combination of early planting and high populations ma provide the desired balance of yields with size control.

c) Environmental Conditions During Stolon Development and Tuber Set.

If a short growing season is going to be used to control tuber size, the question arises whether it better to plant and harvest early, or plant and harvest late. Given the resulting changes in environmental conditions during stolon growth and tuber set, similar length growing seasons could produce dramatically different results.

d) Seed Handling Methods

The physiological age of seed potatoes influences yields and tuber size distribution of the resultin crop. Seed grown in northern latitudes is typically physiologically young. Physiologically young seed tends to produces a large and healthy crop, but tuber set is relatively low resulting in large average tuber size. In seed production, the emphasis is increasingly on production of good yields of tubers suited for us as drop or single cut seed. In varieties such as Shepody, this objective is difficult to achieve as the plants tend to produce low numbers of very large tubers. This situation is exacerbated if young seed is planted, a it already has a tendency to produce low numbers of larger tubers. Tuber size distribution of difficult to handle cultivars such as Shepody may be improved by artificially aging the seed. Ideally this shift in tube size distribution would be achieved without excessive sacrifice in total yields.

e) Generation Effects

As a vegetatively propagated crop, potatoes are prone to spread of disease from generation to generation in the material used as seed. As the number of generations in the field increases, there is a corresponding increase in levels of various viral, fungal and bacterial diseases found in the seed. These pathogens will reduce crop vigor and yield potential, particularly under adverse growing conditions. The rate of increase in levels of seed-borne disease is a function of levels in the parental materials and the efficiency of spread within the crop. In Saskatchewan, the short cool growing season limits the spread of disease within the seed potato crop. Isolation of seed fields further slows the accumulation of disease in th seed. It is therefore expected that the performance of seed of the various generations should be roughly comparable.

f) Moisture Availability

A significant proportion of the seed potatoes produced in Saskatchewan are grown without the benefit of irrigation. Although the dryland production is focussed in regions with relatively high rainfall some degree of moisture stress is common in most years. Moisture stress can influence yields and tuber size distribution, while also influencing the quality and vigor of the resulting seed crop

g) Fertility

The availability of adequate soil nutrients is crucial to the growth and yield of potatoes. The amount of each nutrient required for optimum yields is a function of many factors including, plant populations, cultivar, growing season length, moisture availability and the desired tuber size. Nitrogen is the most aggressively managed nutrient in potato production, but phosphorus and potassium can also strongly influence crop performance.

Progress to Project Completion - March 2000

Site Descriptions

The majority of trials were conducted at the Saskatchewan Irrigation Development Centre in Outlook and at the Potato Research Plots associated with the Department of Plant Sciences at the University of Saskatchewan. The Outlook site features a sandy loam soil, pH 8.1, EC 1.2 dS with 2% O.M. The Outlook site has a limited history of being cropped to potatoes. The University of Saskatchewan site features a sandy loam, pH 7.2, EC < 1 dS, with 4% O.M. The site has been cropped to potatoes on a 3 year rotation with dryland barley for the past 20 years. The plots receive an application of 20 t/ha of cattle manure immediately following the harvest of the potato crop.

Production Practices

Sites were soil tested annually at 15 cm intervals to 45 cm depth. Unless otherwise specified, standard production practices for irrigated commercial potatoes were used in all trials. The fields were double disced prior to planting and sufficient N as 46-0-0 was applied at this time to raise soil N levels to the 175 #/a recommended by Plain Innovative Laboratories for irrigated potatoes. The crop was seeded in mid-May, using single cut or drop type seed treated with Polyram (metiram) as a seedpiece treatment. This planting date and seed treatment corresponds to standard production practices. The crop was seeded in rows 90 cm apart in Outlook and 1 m apart in Saskatoon. In Saskatoon, sufficient phosphorus (11-55-0) was applied in a band adjacent to the seed to raise soil levels to 120#/a. In Outlook, sufficient P was broadcast prior to planting to raise soil P levels to 90 #/a and an additional 50 kg K2O/ha was applied with the seed.

Weed populations were high at the Saskatoon site due to the frequent application of uncomposted manure. The weed control strategy at the Saskatoon site involved pre-plant application of Eptam (EPTC) and Sencor (metribuzin) followed by Gramoxone (paraquat) and Lorox (linuron) at ground crack. In Outlook, only Eptam 8E was applied as a pre-plant herbicide. At both sites, a rolling cultivator was used after ground crack and again three weeks later for inter-row tillage and to throw hills.

The plots were irrigated using a wheel-line system in Saskatoon and a central pivot or linear system at Outlook. Soil moisture levels were monitored in the plots using tensiometers or electrical resistance metres. Unless otherwise specified, the plots were irrigated whenever soil water potentials fell below -60kPa. At the Outlook site a single insecticidal spray was used to control Colorado potato beetles. In 1998 and 1999, beetle pressures were relatively high at the Saskatoon site. Multiple applications of foliar applied insecticides provided adequate control of this pest at this site. No significant disease problems were observed in the 1997 and 1998 trials. In 1999, Late Blight (*Phytophthora infestans*) was observed at both sites. Multiple applications of foliar fungicides effectively controlled this disease - no significant losses in yield potential or crop quality were observed. Unless otherwise specified, the crop was desiccated using two applications of Regalone (diquat) in early September and harvested two to four weeks later.

The crop was graded into size categories; small = < 44 mm diam., 44 < medium < 88 mm and oversize = > 88 mm diam. Potatoes falling into the small and medium size categories were considered suitable for use as seed, while potatoes in the medium and large categories were rated as suitable for use on the table/processing market.

Trial 1. Shepody - Influence of seed spacing and seed type on yields and tuber size distribution under irrigated and dryland conditions

Shepody is an important processing type of potato. It is very early maturing and is used by processors to bridge the gap between the last of the previous year's stored crop and the new crop of later maturing varieties like Russet Burbank. Shepody is one of the most important cultivars of potatoes seed grown for export from Saskatchewan. Shepody is renowned for its limited and unpredictable tuber set, making it a challenging cultivar to grow for seed. It is particularly difficult to produce a high proportion of the crop as the small sized tubers desirable for use as seed. In Saskatchewan, this challenge is further complicated by the fact that a substantial proportion of the seed crop is produced on dryland or with limited irrigation. Insufficient and/or unpredictable moisture supplies makes control of tubers ize distribution difficult. Altering in-row spacing is a popular method for managing tuber size distribution in seed and processing potatoes. Close spacings increase inter-plant competition resulting in high yields with a smaller average tuber size. Unfortunately, close spacing increases seed costs and slows planting. Dryland growers are also reluctant to use higher plant populations in case of drought. An alternative approach is to increase the mainstems produced/unit area by planting whole rather than cut seed.

This trial evaluated the impact of two in-row spacings and use of whole versus cut seed on yields and tuber size distribution of Shepody potatoes under both dryland and irrigated conditions.

The trials were conducted in 1995-1997 at the University of Saskatchewan Potato Field Research Station in Saskatoon and at the C.S.I.D.C. in Outlook (see above for site descriptions). Elite III single cut or equivalent-size drop seed was planted at 26 or 35 cm in-row spacings in mid-May. A 35 cm in row spacing represents the industry standard. Half the plots were irrigated once soil water potentials reached -50 kPa, while the other plots were managed without irrigation. Standard crop maintenance practices were employed. The crop was harvested at 110 DAP, two weeks after chemical desiccation. The crop was graded as previously described.

Data for the three cropping seasons are presented in Table 1.1. Only the 1997 data is discussed, along with the conclusions derived from all three test years.

Outlook Site - Yields under irrigation were more than 100% greater than on dryland. This reflects the scarcity of rainfall during the 1997 cropping season. Responses to the spacing and seed type variables were similar, irrespective of whether the crop was irrigated or grown with rainfall only. Seed piece spacing had no effect on yields, except that the **narrow in-row spacing produced more tubers fitting into the drop size category.** As in previous trials, planting whole seed increased yields of almost all tuber size categories, with marketable yields increased by 19%.

Saskatoon Site - Yields under dryland conditions were very similar to the irrigated plots, yet the irrigated crop received an additional 38 cm of moisture. The dryland plots in this trial showed good vigor throughout the year, yet other dryland plots were obviously moisture stressed. The basis of this anomaly could not be determined. As in the Outlook trial, responses to the spacing and seed type variables were similar, irrespective of whether the crop was irrigated or grown with rainfall only. Unlike the situation in Outlook, seed piece spacing had a strong effect on yields. The close in row spacing produced the larger yields, especially when the trial was grown without added irrigation. As in previous trials, planting whole seed increased yields of the large tuber size categories, with marketable yields increased by an average of

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Table 1.1. **Influence of in-row spacing and seed-type on yields of Shepody potatoes under dryland and irrigated conditions in Saskatoon and Outlook in 1995-1997.**

	1995 Yield (t/ha)			1996 Yield (t/ha)			1997 Yield (t/ha)		
	Total	**Medium**	**Small**	**Total**	**Medium**	**Small**	**Total**	**Medium**	**Small**
OUTLOOK									
Irrigated									
Whole Seed	32.6	26.1	2.2	36.1	28	1.5	32.6	26.8	3
Cut Seed	30.3	25	1.5	27.8	23.6	1.6	28	23.4	2.8
	NS	NS	NS	**	**	NS	**	**	NS
26 cm	34	27.6	2.5	35.4	28.6	1.9	31.6	26.6	3.3
35 cm	29.1	23.5	1.2	28.5	23.1	1.4	28.8	23.6	2.5
	**	*	**	**	**	*	NS	NS	*
Dryland									
Whole Seed	20.6	17.8	2	14.9	11.8	1.8	14.3	8.1	5.5
Cut Seed	18.5	15.9	1.6	13	9.7	1.4	12	6.8	4.7
	*	*	NS	NS	*	*	*	**	NS
26 cm	20.3	17.8	2	14.6	11.2	1.9	13.3	7.3	5.8
35 cm	18.8	16.2	1.6	13.1	10.2	1.2	13.1	7.8	4.5
	NS	*	NS	NS	NS	*	NS	NS	**
SASKATOON									
Irrigated									
Whole Seed	41.1	32.3	5	46.2	37.5	4.1	46.8	39	2.1
Cut Seed	28.9	31.9	3.9	40.8	30.8	3.3	42.6	36.2	2.9
	NS	NS	NS	*	*	NS	**	**	*
26 cm	41.6	32.6	5	47	36.8	4.2	46.6	39.1	3.1
35 cm	37.8	31.5	3.9	10	31.4	3.1	43	36.6	2.2
	NS	NS	NS	*	*	*	**	NS	*
Dryland									
Whole Seed	41.1	33.9	5.4	24.6	16.2	7.2	38.8	33.9	3.2
Cut Seed	40.2	34	4.9	20.2	13.8	5.8	35.8	31.1	2.9
	NS	NS	NS	**	*	**	**	**	*
26 cm	41.9	34.5	5.4	22.2	13.8	7.8	41.2	36.2	3.6
35 cm	39.6	34.6	4.8	22.6	16.2	5.2	33.5	28.6	2.6
	NS	NS	NS	NS	*	**	**	**	*

8%.

Table 1.1. **Influence of in-row spacing and seed-type on yields of Shepody potatoes under dryland and irrigated conditions in Saskatoon and Outlook in 1995-1997.**

	1995 Yield (t/ha)			1996 Yield (t/ha)			1997 Yield (t/ha)		
	Total	Medium	Small	Total	Medium	Small	Total	Medium	Small
OUTLOOK									
Irrigated									
Whole Seed	32.6	26.1	2.2	36.1	28	1.5	32.6	26.8	3
Cut Seed	30.3	25	1.5	27.8	23.6	1.6	28	23.4	2.8
	NS	NS	NS	**	**	NS	**	**	NS
26 cm	34	27.6	2.5	35.4	28.6	1.9	31.6	26.6	3.3
35 cm	29.1	23.5	1.2	28.5	23.1	1.4	28.8	23.6	2.5
	**	*	**	**	**	*	NS	NS	*
Dryland									
Whole Seed	20.6	17.8	2	14.9	11.8	1.8	14.3	8.1	5.5
Cut Seed	18.5	15.9	1.6	13	9.7	1.4	12	6.8	4.7
	*	*	NS	NS	*	*	*	**	NS
26 cm	20.3	17.8	2	14.6	11.2	1.9	13.3	7.3	5.8
35 cm	18.8	16.2	1.6	13.1	10.2	1.2	13.1	7.8	4.5
	NS	*	NS	NS	NS	*	NS	NS	**
SASKATOON									
Irrigated									
Whole Seed	41.1	32.3	5	46.2	37.5	4.1	46.8	39	2.1
Cut Seed	28.9	31.9	3.9	40.8	30.8	3.3	42.6	36.2	2.9
	NS	NS	NS	*	*	NS	**	**	*
26 cm	41.6	32.6	5	47	36.8	4.2	46.6	39.1	3.1
35 cm	37.8	31.5	3.9	10	31.4	3.1	43	36.6	2.2
	NS	NS	NS	*	*	*	**	NS	*
Dryland									
Whole Seed	41.1	33.9	5.4	24.6	16.2	7.2	38.8	33.9	3.2
Cut Seed	40.2	34	4.9	20.2	13.8	5.8	35.8	31.1	2.9
	NS	NS	NS	**	*	**	**	**	*
26 cm	41.9	34.5	5.4	22.2	13.8	7.8	41.2	36.2	3.6
35 cm	39.6	34.6	4.8	22.6	16.2	5.2	33.5	28.6	2.6
	NS	NS	NS	NS	*	**	**	**	*

Conclusions.

This trial clearly demonstrated the unpredictability of Shepody in terms of its responses to management variables such as seed type, in-row spacing and moisture availability. Use of whole seed was generally beneficial (or occasionally neutral) in terms of its effects on yields. Seed type had no effect on tuber size distribution; using whole seed increased yields in all size categories. **Planting the seed closer together in the rows was consistently effective at both increasing yields and shifting tuber size distribution towards the size desired for seed use. The benefits of close in-row spacings were most apparent when the crop was provided with ample moisture.** It is noteworthy that the close in-row spacing did not have any detrimental effects on yields in any of the dryland trials. Based on the data presented, dryland growers may be able to safely consider increasing plant populations. This would increase yield potential in wet years without presenting an undue risk (except the added cost of seed) in dry years.

Trial 2. Influence of Seed Handling Regimes on Shepody Yields and Tuber Size Distribution

The physiological age of seed potatoes can influence yields and tuber size distribution of the resulting crop. Seed grown in northern latitudes is typically physiologically young. Physiologically young seed has the following characteristics;

a) slow to sprout during storage and after planting
b) produces relatively few mainstems and therefore tends to produce relatively few tubers
c) slow to set tubers
d) produces a large and healthy canopy
e) has high yield potentials under long growing seasons
f) tuber set is relatively low resulting in large average tuber size.

In seed production, the emphasis is increasingly on production of good yields of tubers suited for use as drop or single cut seed. In varieties such as Shepody, this objective is difficult to achieve as the plants tend to produce low numbers of very large tubers. This situation is exacerbated if young seed is planted, as it already tends to produce low numbers of larger tubers.

This study was designed to determine if the tuber size distribution of Shepody could be improved by artificially aging the seed. Ideally, this shift in tuber size distribution would be achieved without excessive sacrifice in total yields.

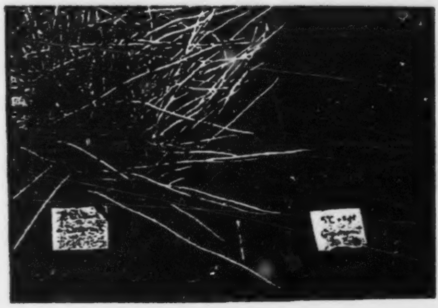
This trial was conducted from 1996 through 1999 at the University of Saskatchewan Potato Field Research Station in Saskatoon (see above for site description). Elite 2 drop seed of Shepody was obtained from a Saskatchewan seed grower in late April. The seed had been in storage at 4C since harvest. The seed was graded for uniformity before being subjected to one of the following treatments;

a) Greensprouting -	seed was exposed to banks of fluorescent light (350 uM/M^2/s) for 24h/day at 15C for 3 weeks. At the end of the treatment period the seed was returned to 4C storage until planting in mid-May.
b) Dark Sprouting -	seed was held at 15C for the same period as the greensprouted seed except that it was held in the dark. At the end of the treatment period this seed was also returned to 4C storage until planting in mid-May.
c) Advanced Aging -	this seed was held at 15C in the dark from early April until planting (39 days). This seed was desprouted just prior to planting as otherwise it would not have passed through the planter.
d) No aging -	seed was stored cold (4C) until 48 hours prior to planting.
e) No aging/cut -	seed stored cold until just prior to planting was cut to produce seedpieces approximately the same size as the drop seed used in the other treatments.

The crop was planted, managed, harvested and graded according to standard practices. All crops were grown under irrigation, using a 23cm in-row spacing.

Results

Sprout Development



Sprout Length at Planting (1996)

Greensprouted	1.52 cm +/- 0.68
Dark Sprouted	3.03 cm +/- 1.32
Advanced Aging	41.43 cm +/- 23.2
4 C storage (whole)	1.03 cm +/- 0.47
4 C storage (cut)	0.80 cm +/- 0.52

Sprout growth at planting was influenced by both the duration of exposure to warm conditions and the light levels during the pre-treatment. The advance aging treatment produced very large sprouts which had to be removed to allow machine planting. Pre-treatment for shorter periods caused more limited sprouting, with greensprouting producing shorter, stockier sprouts than when the seed was held in the dark. The more robust sprouts produced by the greensprouting treatment were better able to tolerate handling during the subsequent planting operations.

Emergence and Crop Development

None of the aging treatments had any impact on plant stand. However, as illustrated by Figures 2.1 and 2.2, the accelerated aging and greensprouting treatments were very effective at promoting rapid crop emergence. Rapid emergence is highly desirable in situations where soil-borne diseases may attack slow developing sprouts or when early season weed pressure threatens to overwhelm the crop. In this trial, no obvious benefits of early emergence were observed.

Figure 2.1 Emergence of Shepody potatoes following various seed aging treatments. The fully emerged rows are the greensprouted and accelerated aging treatments.

Figure 2.2. Flowering of Shepody potatoes given various seed aging treatments. The rows with the most advanced flowering are the greensprouted and accelerated aging treatments.

As the various seed treatments had similar effects on yields in all four test seasons, treatment averages are presented in Table 2.1. The most significant seed treatment effect was that **seed stored cold until just prior to planting and then cut produced yields which were consistently lower than all other treatments**. As this treatment closely resembles the standard practice used by many growers, there is clearly room for improvement in seed handling practices. Whole seed stored cold until just prior to treatments. As this treatment closely resembles the standard practice used by many growers, there is clearly room for improvement in seed handling practices. Whole seed stored cold until just prior to planting performed well in all trials. This demonstrates the superior stress tolerance of whole seed versus cut. Although the greensprouting and accelerated aging treatments clearly accelerated crop emergence relative to all other treatments, they did not produce any consistent improvement in yields or tuber size distribution relative to any of the other aging treatments.

Table 2.1. **Influence of seed handling regimes on yields and tuber size distribution of Shepody seed potatoes (average 1996-1999).**

	Yields (t/ha)			AVERAGE TUBER WT (g)
	TOTAL	MEDIUM	DROP SEED	
Green Sprouted	41.8	33.3 (80)	3.1 (7)	214
Short Term Aged	41.6	33.2 (80)	3.0 (7)	217
Long Term Aged	36.1	29.1 (81)	3.8 (10)	178
No Aging (Whole)	38.5	31.4 (81)	3.7 (10)	197
No Aging (Cut)	33.4	26.3 (81)	3.1 (10)	186
LSD (0.05)	7.2	6.2	1.1	27

Values in brackets represent the % of the crop falling into each size category.

The yield and tuber size distribution responses to the seed handling treatments used in this trial were limited. Shepody may simply be unresponsive to seed handling treatments of this nature. Alternatively, production conditions may not have been conducive to the expression of treatment effects. More vigorous treatments involving longer pre-treatment or more extreme temperatures might produce more dramatic results. However, most treatments were already approaching the practical limit imposed by the need to handle the seed without excessive damage to the sprouts.

An alternative approach might be age the crop either in the field or earlier during the storage period. High temperatures and other stresses such as defoliation by insects or disease are known to increase the physiological age of seed. Adequate control of field conditions is difficult. Exposing a newly harvested, dormant crop to higher storage temperatures may allow for more extensive aging without causing excessive sprout development.

Trial 3. Norland, Shepody, Burbank, Atlantic, Russet Burbank and Norkotah - Irrigation Study

In Saskatchewan, seed potatoes are produced under both dryland and irrigated conditions. Yield potential and tuber size distribution of potatoes are strongly influenced by overall moisture availability and seasonal distribution. For example, transient moisture stress during stolon formation or tuber initiation can reduce tuber set, while moisture stress at tuber bulking stage can reduce tuber size. The effects of moisture stress vary between cultivars and can be further complicated by management variables such as planting date, plant populations, anticipated end-use etc.

This study examined the influence of three irrigation regimes on yields and tuber size distribution of several locally popular cultivars grown at three plant population densities. The trial was conducted in 1995-1999 but this report will be limited to the 1997 - 1999 AFIF funded trials.

This trial was conducted at the Irrigation Development Centre in Outlook (see above for site description). Elite III single cut seed of the various test varieties was planted in mid May. Plots were seeded at 15, 20 and 30 cm in-row spacings. There was 90 cm between rows. Plots were overhead irrigated when soil moisture content reached 65% or 40% of field capacity. Another portion of the crop was grown without supplemental irrigation.

1997 Results

Rainfall during the 1997 growing season in Outlook totalled 17.4 cm. An additional 22 cm of water was used when the soil was allowed to dry to 40% of FC prior to irrigation. Where the plots were irrigated at 65% FC, total additional moisture applied was 30.5 cm.

The yield results for the trial are summarized in Table 3.1. Under dryland conditions, the seed yield averaged over spacings and cultivars was 15.8 t/ha. When the field was irrigated at 40% FC, yields were 162% greater than dryland. Watering at 65% FC increased yields by an additional 24%. Under dryland conditions, in-row spacing had no impact on yields. When the crop was irrigated at 40% FC, reducing the in-row spacing increased yields, although the difference between yields at the 15 and 20 cm spacings was minimal. All cultivars showed a similar response to in-row spacing under the 40% irrigation regime. When the crop was irrigated at 65% FC, the in-row spacing had relatively little effect on yields averaged over the various cultivars. For Atlantic, Norland and Russet Norkotah, the closer the in-row spacing the higher the yields obtained. The cv. Shepody produced its highest yields with a 20 cm in-row spacing, while in Russet Burbank, the 20 cm spacing produced poor yields.

These results demonstrate the importance of abundant moisture in potato production. Although responses to spacing varied across irrigation regimes and cultivars, the 20 cm spacing most often provided the desired combination of high yields without excess seed costs.

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Table 3.1. **Seed grade tuber yields for selected potato cultivars grown at different plant populations and irrigation regimes - 1997.**

Factor	Level	Seed grade tuber yield					
		Dryland		40% Field capacity		65% Field capacity	
		t/ha	Cwt./ac	t/ha	Cwt./ac	t/ha	Cwt./ac
Cultivar[z]	Atlantic	17.8	159	40.6	362	54.2	484
	Norland	17	152	43.6	389	52.6	469
	Russet Burbank	15.5	138	44.1	393	51.4	459
	Russet Norkotah	13.6	121	44.4	396	49.7	443
	Shepody	15.1	135	35.6	318	49.6	443
Spacing[y]	15 cm	15.8	141	44.4	396	52.8	471
	20 cm	16.3	145	42.9	383	52.9	472
	30 cm	15.3	136	37.6	335	48.8	435
Analyses of Variance							
Source							
Cultivar		***(1.9)		*(6.4)		NS	
Spacing		NS		*(5.0)		*(3.4)	
Cultivar x Spacing		NS		NS		**(7.7)	
CV (%)		14.6		18.7		10.5	

[z] Average of spacing. [y] Average of cultivars.

1998 Results

Potato grown under dryland conditions produced the lowest 'seed' grade yield of 40.8 t/ha (Table 3.2). Plots maintained at 40% F.C and 65% F.C produced the highest and intermediate yields respectively (Table 3.2). The 40% soil moisture regime produced 41% higher 'seed' grade yield than dryland production. The 65% F.C. produced on the average 7% lower yield than the 40% F.C. soil moisture treatment.

Norland produced the highest and Shepody the lowest 'seed' grade yields under all irrigation regimes. The yield differences were 68% under dryland, 104% under 40% F.C., and 80% under 65% F.C. (Table 3.2).

Increasing plant population by decreasing seed piece spacing increased 'seed' grade tuber yields under all moisture regimes. The yield differences were more marked between the 30 cm and 20 cm spacing compared to the 20 cm and 15 cm spacing (Table 3.2). The 20 cm spacing outyielded the 30 cm spacing by 9%, 18%, and 19% under dryland, 40%F.C, and 65% F.C respectively. The corresponding differences between the two higher plant populations were 5%, 6%, and 1%.

Table 3.1. **Seed grade tuber yields for selected potato cultivars grown at different plant populations and irrigation regimes - 1997.**

Factor	Level	Seed grade tuber yield					
		Dryland		40% Field capacity		65% Field capacity	
		t/ha	Cwt./ac	t/ha	Cwt./ac	t/ha	Cwt./ac
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	20 cm	16.3	145	42.9	383	52.9	472
	30 cm	15.3	136	37.6	335	48.8	435
Analyses of Variance							
Source							
Cultivar		***(1.9)		*(6.4)		NS	
Spacing		NS		*(5.0)		*(3.4)	
Cultivar x Spacing		NS		NS		**(7.7)	
CV (%)		14.6		18.7		10.5	

[z] Average of spacing. [y] Average of cultivars.

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Table 3.2. 'Seed' grade tuber yield for potato cultivars grown under different seed piece spacings and soil moisture regimes - 1998.

Treatment	Dryland		40% Field capacity		65% Field capacity	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Cultivar[1]						
Atlantic	45.8	409	58.7	524	54.4	486
Norland	47.6	425	72.7	649	68	607
Russet Burbank	37.3	333	51.2	457	43.3	387
Russet Norkotah	44.8	400	69	616	64.1	572
Shepody	28.3	253	35.6	318	37.7	337
Spacing[2]						
15 cm	43.3	387	62.7	560	56.8	507
20 cm	41.3	369	59.3	530	56.3	503
30 cm	37.8	338	50.4	450	47.4	423
Analysis of variance						
Source						
Cultivar (C)	***(5.1 t/ha)		***(4.8 t/ha)		***(5.0 t/ha)	
Spacing (S)	*(3.9 t/ha)		**(7.6 t/ha)		***(3.9 t/ha)	
C x S	NS[3]		NS		NS	
C.V. (%)	15.1		20.7		11.4	

[1] Average of seed piece spacing. [2] Average of cultivars. [3] not significant

Values within parentheses are LSD (0.05) estimates for the respective treatments.

1999 Results

The 1997 and 1998 studies had shown that irrigation was beneficial to potato production and that moisture stress could cause severe yield losses and negatively affect tuber quality. Lower levels of drought stress were better tolerated, particularly by certain varieties. When the crop was adequately supplied with moisture, increasing the plant population increased yields. Where moisture deficits occurred, increasing the plant population had neither negative nor positive effects on yields.

The 1999 trial compared the performance of Atlantic, Norland, Russet Burbank, Russet Norkotah, and Shepody potato at three seed piece spacings (15, 20, 30 cm) under three irrigation regimes (dryland, 40% FC, 65% FC).

The 1999 growing season received 207 mm (8.1 in) rain. Supplementary irrigation of 100 mm and 140 mm applied to maintain the soil moisture status at 40% and 65% FC respectively.

The abundant and well distributed precipitation during the 1999 growing season resulted in above average yields under dryland conditions. Dryland production on the average produced 44.7 t/ha'seed' grade yield (Table 3.4). Soil maintained at 40% FC produced 4% higher 'seed' grade and soil maintained at 65% FC produced 7% higher 'seed' grade than the dryland trial.

Russet Norkotah potato produced the highest and Shepody the lowest 'seed' grade under all moisture

Table 3.2. 'Seed' grade tuber yield for potato cultivars grown under different seed piece spacings and soil moisture regimes - 1998.

Treatment	Dryland		40% Field capacity		65% Field capacity	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
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C x S	NS[3]		NS		NS	
C.V. (%)	15.1		20.7		11.4	

[1]Average of seed piece spacing. [2]Average of cultivars. [3]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

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Russet Norkotah potato produced the highest and Shepody the lowest 'seed' grade under all moisture regimes (Table 3.4).

The widest seed piece spacing (30 cm) produced the lowest 'seed' grade yield under all moisture regimes (Table 3.4). Increasing plant populations by reducing the within-row spacing to 20 cm produced 13%-14% higher 'seed' grade yield than the 30 cm spacing. Tighter planting by further reducing the within-row spacing to 15 cm was not advantageous, instead tended to reduce 'seed' grade yield slightly compared to the mid seed piece spacing of 20 cm at all moisture regimes (Table 3.4).

The cultivar x seed piece spacing interaction were significant for 'seed' grade yield under 40% FC (Table 3.4, Figure 3.1). Under 40% FC, the yield for Atlantic decreased with increase in seed piece spacing, by contrast the yield for Russet Burbank increased slightly with further increase in spacing. Shepody and Russet Norkotah produced the highest 'seed' grade yield at the 20 cm spacing compared to the higher and the lower spacings tested.

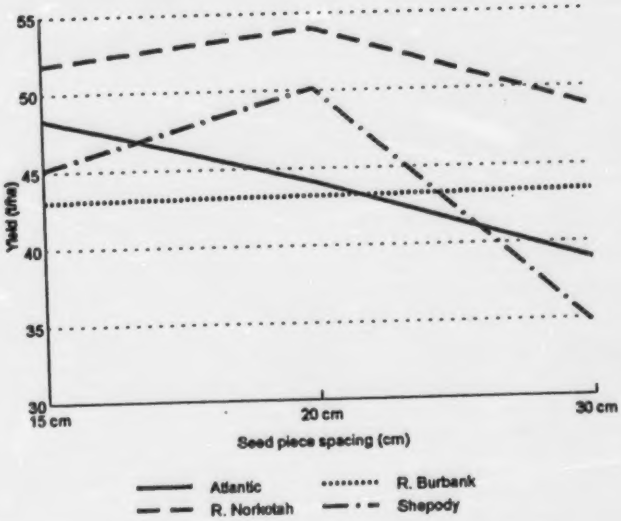

Figure 3.1. Interactive effects of cultivar and seed piece spacing for 'seed' grade yield under 40% Field Capacity

Table 3.4. Seed piece spacing effects on seed grade yield for potato cultivars grown under different irrigation regimes in 1999.

Treatment		Yield (t/ha)		
		Dryland	40% Field Capacity	65% Field Capacity
Cultivar:	Atlantic	44.0	43.8	49.8
	Norland	45.9	50.7	49.2
	Russet Burbank	42.8	43.2	44.0
	Russet Norkotah	47.8	51.5	50.8
	Shepody	43.0	43.3	42.3
Spacing:	15 cm	45.8	48.2	47.4
	20 cm	46.9	48.4	50.1
	30 cm	41.3	43.0	44.2
Analyses of Variance				
Source:				
Cultivar (C)		***(2.4)	***(3.8)	***(4.7)
Spacing (S)		***(1.9)	***(2.9)	**(3.7)
C x S		ns	*(6.6)	ns
C.V. (%)		6.5	9.9	12.1

***, **, *, and ns indicate significance at P<0.001, 0.01, 0.05 levels of probability and not significant respectively.

Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Conclusion:

Irrigation is beneficial for all types of potato production as it increases yields and enhances crop quality. The benefits of supplemental irrigation are influenced by many factors including crop moisture requirements and evaporational demand versus available rainfall, the distribution pattern of rainfall, relative tolerances of imperfections in tuber shape etc. A substantial portion of Saskatchewan's seed potatoes are grown on dryland. In this three year study, the benefits of supplemental irrigation for seed potato production in Saskatchewan were clearly demonstrated. Dryland yields were exceptionally low during the very dry 1997 growing season. By contrast, under normal rainfall conditions in 1998 and 1999 dryland yields were more than double compared to 1997. Application of moderate amounts of supplemental irrigation, i.e. maintaining the soil status moisture around 40%-50% FC, was sufficient to excellent yields. **This suggests that substantial benefits can be obtained with even small amounts of supplemental moisture.** Maintaining the fields at 65% FC did produce the highest yields in most situations - although a cost benefit analysis may suggest that added yields were not adequate to offset the costs of the more extensive irrigation regime.

Crop requirements for moisture are influenced by biotic factors including plant populations. In this study, the closer in-row spacing (=highest plant populations) consistently produced higher yields than wider spacing, irrespective of moisture availability. The positive effect of high plant populations on yields was even apparent under dryland conditions although in seasons when rainfall was extremely scarce the effect

of seedpiece spacing was minimal. These results suggest that Saskatchewan's seed potato growers should be opting for high plant populations irrespective of their ability to irrigated their crops.

Although there were significant differences between the cultivars in terms of their yield potential, all the cultivars tested responded similarly to changing moisture availability. This runs contrary to most growers perception that some cultivars are more drought tolerant or resistant than others.

Trial 4. Shepody and Ranger - Time of planting and seed type

In an effort to control tuber size of difficult to manage cultivars such as Shepody, growers may opt to limi the growth period by planting late or harvesting early. However, with indeterminant cultivars like Shepody and Ranger, delayed planting may substantially reduce yield potential. Similarly, early harvest may substantially reduce yields in indeterminant, long season cultivars. Whole seed is considered to be les susceptible to the low soil temperatures and delayed emergence associated with early and/or deep planting.

This study examined the impact of delayed planting and seed type on yields and tuber size distribution of Shepody and Ranger Russet potatoes. This trial was conducted in 1995-1997, but only the results for the 1997 AFIF funded trial are reported.

This trial was conducted at the University of Saskatchewan Potato Field Research Station in Saskatoon (see above for detailed site description). Elite III single cut or equivalent size drop seed of Shepody and Ranger Russet was planted on May 10 or June 1. The plot was irrigated once soil water potentials reached -50 kPa. Standard crop maintenance practices were employed. The crop was harvested at 110 DAP, two weeks after chemical desiccation. The crop was graded as previously described.

Results

Rangers - Early planting resulted in a significant increase in total yields, with the majority of the response occurring in the medium size category (Table 4.1). Both the number of tubers produced and the average size of the tubers was increased by early planting. Planting whole seed produced a less dramatic but nonetheless significant increase in yields, with the medium size category again showing the greatest response. Planting whole seed tended to increase tubers set more than the average size of each tuber. The effects of seed type of yields and tuber size distribution was not influenced by the planting date variable.

Shepody - Responses to the planting date and seed type variables were very similar to Ranger. Early planting resulted in a significant increase in total yields, with all size categories showing significant responses (Table 4.1). Both the number of tubers produced and the average size of the tubers was increased by early planting. Planting whole seed produced a less dramatic but nonetheless significant increase in yields, with the oversize and medium size categories showing the greatest response. Planting whole seed had less of an effect on tuber set in Shepody than in the Rangers. It is noteworthy that the effects of seedtype on tuber yields and size distribution of Shepody were only significant in the early planted crop (Table 4.2). The limited yield potential of the late planted crop appears to have restricted the potential benefits of planting whole seed.

Conclusion:

Responses to the planting date and seed type variables were not consistent across the three test seasons. Early planting increased yields in 1995 and 1997, but had relatively little effect in 1996. In 1995 and 1997, the loss in yield potential associated with delayed planting far exceeded expectations. This may reflect the nature of the 1995 and 1997 growing seasons. Conditions early in the season were superior to later. In 1995, most of August was lost to cool, wet weather. In 1997, July and August were exceptionally hot and dry. In 1996 and 1997 planting whole seed resulted in substantial enhancement of yields. This yield response likely reflects a) superior plant stands with whole seed due to reduction in seedpiece decay and b) greater tuber numbers produced with whole seed. Whole seed tends to produce more mainstems than cut - this in turn promotes tuber set.

Table 4.1. Influence of Planting Date and Seed Type on Yields and Tuber Size Distribution of Ranger Russet and Shepody Potatoes (1997).

Treatment	Yield (t/ha)			Average Tuber Wt. (g)
	Total	Marketable	Drop Size	
Ranger				
Early Planting	55.8	48.1	4.4	210
Late Planting	27.0	22.9	3.0	162
	**	**	**	**
Whole Seed	44.9	38.1	4.4	180
Cut Seed	37.9	33.0	3.0	191
	**	**	**	NS
Shepody				
Early Planting	44.4	29.6	3.1	267
Late Planting	14.1	10.0	2.2	128
	**	**	**	**
Whole Seed	33.3	22.2	3.0	203
Cut Seed	25.1	17.5	2.5	192
	**	**	NS	NS

Table 4.2. Interaction between planting date and seed type for cv Shepody (1997).

	Yield (t/ha)			Average Wt. (g)
	Total	Marketable	Drop Size	
Early Planting				
Whole Seed	50.8a*	33.5a	2.2b	283a
Cut Seed	38.1b	25.9b	2.1b	252b
Late Planting				
Whole Seed	16.0c	11.0c	3.5a	122c
Cut Seed	12.2c	9.0c	2.8a	132c

*Values within columns followed by the same letter are not significantly different ($p = 0.05$).

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Trial 5. Shepody and Norkotah - Planting/Harvest Date Trial

Seed growers attempting to control tuber size by shortening the growing season, have the option of planting late or harvesting early. **This study examined yields and tuber size distribution for several cultivars of potatoes when the crop was grown for three different 90 day intervals. Trials were conducted from 1996-1999. Only the AFIF funded trials are discussed in detail.**

The trials were conducted in Saskatoon on the Horticulture Science Department Potato Research Plots (detailed descriptions above). Elite III single cut seed was planted in mid-May, late May or mid-June for harvest 90 days later (mid-Aug, late Aug or mid-September). There was 1 m between rows. The trials were conducted under irrigated and dryland conditions. Plots were irrigated once soil water potentials reached -50 kPa. Standard crop maintenance practices were employed. The trials were arranged in a randomized complete block design. The cultivars and irrigation treatments were managed in separate trials. There were four replicates. The crop was managed, harvested and graded as previously described.

In 1997 and 1998, Shepody and Russet Norkotah were tested, while in 1999, Russet Burbank and Ranger Russet were evaluated.

1997 Results

In the dryland trials, the two cultivars responded in a similar manner to the planting/harvest dates (Table 5.1). The second and third planting/harvest date produced superior total yields and yields of medium size tubers. In the Norkotahs, the first planting produced the largest proportion of drop size seed.

Table 5.1. Yields and tuber size distribution for Russet Norkotah and Shepody potatoes grown for 90 days at three points during the 1997 season - dryland trial.

	Total		Medium		Drop		Avg. Wt. (g)
	t/ha	000/ha	t/ha	000/h	t/ha	000/ha	
Russet Norkotah							
May 15 - Aug 15	14.6 a	147 a	8.6 b	66 a	5.9 a	88 a	100 b
May 30 - Aug. 30	16.8 a	155 a	12.0 a	77 a	4.8 ab	78 a	109 ab
June 15 - Sept. 15	13.8 a	114 b	10.2 ab	64 a	3.2 b	50 b	121 a
Shepody							
May 15 - Aug. 15	14.0 b	130 b	9.8 b	70 b	3.4 a	59 b	130 c
May 30 - Aug. 30	21.5 a	190 a	16.1 a	101 a	4.4 a	87 a	156 b
June 15 - Sept. 15	19.5 a	138 b	16.1 a	95 ab	3.1 a	45 b	186 a

For each cultivar, values within columns followed by the same letter are not significantly different.

Under irrigation, the earliest planting/harvest combination was superior in all yield categories for the Norkotahs, while the middle combination was optimal for the Shepodys (Table 5.2).

The results from the trial are not unexpected given the growing conditions encountered in 1997. The 1997 growing season was exceptionally hot and dry through July and mid-August. Soil water potentials indicated severe moisture deficits in the plots from July onwards. The early planted crop grown without irrigation was exposed to adverse conditions throughout tuber set and bulking, resulting in poor yields relative to the later planting/harvest options. However, when irrigation was available, the heat was favorable to canopy development resulting in superior yields for the first or second planting combinations.

The Shepodys were less adversely affected by the drought stress than the Norkotahs. This may be related to the slower developing Shepodys may have undergone tuber set and enlargement late in the season under more favorable conditions.

Table 5.2. Yields and tuber size distribution for Russet Norkotah and Shepody potatoes grown for 90 days at three points during the 1997 season - irrigated trial.

	Total		Medium		Drop		Avg. Wt. (g)
	t/ha	000/ha	t/ha	000/ha	t/ha	000/ha	
Russet Norkotah							
May 15 - Aug 15	47.8 a	227 a	38.5 a	167 a	3.0 a	50 a	209 a
May 30 - Aug 30	35.0 b	175 b	29.8 b	131 b	2.2 a	36 a	209 a
June 15 - Sept 15	33.2 b	153 b	27.6 b	101 b	3.2 a	50 a	212 a
Shepody							
May 15 - Aug 15	17.4 b	120 a	12.3 b	64 b	2.2 a	53 a	150 a
May 30 - Aug 30	28.2 a	150 a	22.8 a	112 a	2.2 a	43 a	178 a
June 15 -Sept 15	18.9 a	120 a	14.8 b	71 b	2.8 a	48 a	155 a

For each cultivar, values within columns followed by the same letter are not significantly different.

1998 Trial

The middle planting/harvest combination produced the highest total yields for cv. Norkotah, with a large proportion of the crop reaching the oversize category. The latest planting/harvest combination produced the highest proportion of drop-size seed tubers. For cv. Shepody, the latest planting/harvest combination produced the significantly lower yields of medium and large sized tubers; but again, late planting increased yields of drop-sized seed. The average size of the tubers for cv. Shepody decreased progressively as the time of planting/harvest was delayed.

Table 5.2. Yields and tuber size distribution for Russet Norkotah and Shepody potatoes grown for 90 days at three points during the 1998 season.

	Total		Medium		Drop		Avg. Wt. (g)
	t/ha	cwt/a	t/ha	000/h	t/ha	000/ha	
Russet Norkotah							
mid-May to mid-Aug	**27.7 b**	**247 b**	**24.4 a**	**218 a**	**2.6 b**	**23 b**	**183 a**
late May to late Aug	**35.8 a**	**319 a**	**28.6 a**	**255 a**	**2.2 b**	**20 b**	**199 a**
mid-June to mid-Sept	**30.8 ab**	**274 ab**	**25.5 a**	**227 a**	**4.2 a**	**37a**	**180 a**
Shepody							
mid-May to mid-Aug	**25.4 a**	**226 a**	**12.3 b**	**109 b**	**2.0 b**	**18 b**	**163 a**
late May to late Aug	**28.7 a**	**256 a**	**22.8 a**	**203 a**	**3.3 ab**	**29 ab**	**151 a**
mid-June to mid-Sept	**13.4 b**	**119 b**	**14.8 b**	**132 b**	**4.1 a**	**36 a**	**111 b**

For each cultivar, values within columns followed by the same letter are not significantly different.

Trial 5. Shepody and Norkotah - Planting/Harvest Date Trial

Seed growers attempting to control tuber size by shortening the growing season, have the option of planting late or harvesting early. **This study examined yields and tuber size distribution for several cultivars of potatoes when the crop was grown for three different 90 day intervals. Trials were conducted from 1996-1999. Only the AFIF funded trials are discussed in detail.**

The trials were conducted in Saskatoon on the Horticulture Science Department Potato Research Plots (detailed descriptions above). Elite III single cut seed was planted in mid-May, late May or mid-June for harvest 90 days later (mid-Aug, late Aug or mid-September). There was 1 m between rows. The trials were conducted under irrigated and dryland conditions. Plots were irrigated once soil water potentials reached -50 kPa. Standard crop maintenance practices were employed. The trials were arranged in a randomized complete block design. The cultivars and irrigation treatments were managed in separate trials. There were four replicates. The crop was managed, harvested and graded as previously described.

In 1997 and 1998, Shepody and Russet Norkotah were tested, while in 1999, Russet Burbank and Ranger Russet were evaluated.

1997 Results

In the dryland trials, the two cultivars responded in a similar manner to the planting/harvest dates (Table 5.1). The second and third planting/harvest date produced superior total yields and yields of medium size tubers. In the Norkotahs, the first planting produced the largest proportion of drop size seed.

Table 5.1. Yields and tuber size distribution for Russet Norkotah and Shepody potatoes grown for 90 days at three points during the 1997 season - dryland trial.

	Total		Medium		Drop		Avg. Wt. (g)
	t/ha	000/ha	t/ha	000/h	t/ha	000/ha	
Russet Norkotah							
May 15 - Aug 15	14.6 a	147 a	8.6 b	66 a	5.9 a	88 a	100 b
May 30 - Aug. 30	16.8 a	155 a	12.0 a	77 a	4.8 ab	78 a	109 ab
June 15 - Sept. 15	13.8 a	114 b	10.2 ab	64 a	3.2 b	50 b	121 a
Shepody							
May 15 - Aug. 15	14.0 b	130 b	9.8 b	70 b	3.4 a	59 b	130 c
May 30 - Aug. 30	21.5 a	190 a	16.1 a	101 a	4.4 a	87 a	156 b
June 15 - Sept. 15	19.5 a	138 b	16.1 a	95 ab	3.1 a	45 b	186 a

For each cultivar, values within columns followed by the same letter are not significantly different.

Under irrigation, the earliest planting/harvest combination was superior in all yield categories for the Norkotahs, while the middle combination was optimal for the Shepodys (Table 5.2).

The results from the trial are not unexpected given the growing conditions encountered in 1997. The 1997 growing season was exceptionally hot and dry through July and mid-August. Soil water potentials indicated severe moisture deficits in the plots from July onwards. The early planted crop grown without irrigation was exposed to adverse conditions throughout tuber set and bulking, resulting in poor yields relative to the later planting/harvest options. However, when irrigation was available, the heat was favorable to canopy development resulting in superior yields for the first or second planting combinations.

The Shepodys were less adversely affected by the drought stress than the Norkotahs. This may be related to the slower developing Shepodys may have undergone tuber set and enlargement late in the season under more favorable conditions.

Table 5.2. Yields and tuber size distribution for Russet Norkotah and Shepody potatoes grown for 90 days at three points during the 1997 season - irrigated trial.

	Total		Medium		Drop		Avg. Wt. (g)
	t/ha	000/ha	t/ha	000/ha	t/ha	000/ha	
Russet Norkotah							
May 15 - Aug 15	47.8 a	227 a	38.5 a	167 a	3.0 a	50 a	209 a
May 30 - Aug 30	35.0 b	175 b	29.8 b	131 b	2.2 a	36 a	209 a
June 15 - Sept 15	33.2 b	153 b	27.6 b	101 b	3.2 a	50 a	212 a
Shepody							
May 15 - Aug 15	17.4 b	120 a	12.3 b	64 b	2.2 a	53 a	150 a
May 30 - Aug 30	28.2 a	150 a	22.8 a	112 a	2.2 a	43 a	178 a
June 15 -Sept 15	18.9 a	120 a	14.8 b	71 b	2.8 a	48 a	155 a

For each cultivar, values within columns followed by the same letter are not significantly different.

1998 Trial

The middle planting/harvest combination produced the highest total yields for cv. Norkotah, with a large proportion of the crop reaching the oversize category. The latest planting/harvest combination produced the highest proportion of drop-size seed tubers. For cv. Shepody, the latest planting/harvest combination produced the significantly lower yields of medium and large sized tubers; but again, late planting increased yields of drop-sized seed. The average size of the tubers for cv. Shepody decreased progressively as the time of planting/harvest was delayed.

Table 5.2. Yields and tuber size distribution for Russet Norkotah and Shepody potatoes grown for 90 days at three points during the 1998 season.

	Total		Medium		Drop		Avg. Wt. (g)
	t/ha	cwt/a	t/ha	000/h	t/ha	000/ha	
Russet Norkotah							
mid-May to mid-Aug	**27.7 b**	**247 b**	**24.4 a**	**218 a**	**2.6 b**	**23 b**	**183 a**
late May to late Aug	**35.8 a**	**319 a**	**28.6 a**	**255 a**	**2.2 b**	**20 b**	**199 a**
mid-June to mid-Sept	**30.8 ab**	**274 ab**	**25.5 a**	**227 a**	**4.2 a**	**37a**	**180 a**
Shepody							
mid-May to mid-Aug	**25.4 a**	**226 a**	**12.3 b**	**109 b**	**2.0 b**	**18 b**	**163 a**
late May to late Aug	**28.7 a**	**256 a**	**22.8 a**	**203 a**	**3.3 ab**	**29 ab**	**151 a**
mid-June to mid-Sept	**13.4 b**	**119 b**	**14.8 b**	**132 b**	**4.1 a**	**36 a**	**111 b**

For each cultivar, values within columns followed by the same letter are not significantly different.

The 1998 growing season was exceptionally dry from planting through late July. When irrigation was available, the heat was favorable to canopy development. Yields for cv. Norkotah were largely unaffected by the planting/harvest date used. By contrast, in the slower developing cv. Shepody, the latest planting/harvest combination resulted in exceptionally poor yields. Growing conditions were generally favorable throughout the development of this treatment. However this planting/harvest combination was exposed to the high populations of Colorado Potato Beetles (CPB). The defoliation caused by the beetles may have contributed to the poor showing of the late planted treatment. Populations of CPB in 1998 were much higher than in previous test years.

1999 Trial

Spring and early summer of 1999 were cooler and wetter than normal. Little supplemental irrigation was required until August. Cool temperatures minimized the need for irrigation from September through until the end of the cropping season. The environmental characteristics of the three growing periods are presented in Table 5.3.

Table 5.3. Environmental characteristics for three growing periods during the 1999 cropping season.

Cropping Period	Rainfall (cm)	Irrigation (cm)	GDD* - Air	GDD* - Soil
May14-Aug 24	25.5	14	1050	1264
May27-Sept 10	22.6	14	1145	1381
June4-Oct 1	23.1	14	1164	1380

* GDD base = 5°C

The three cropping periods were comparable in terms of total moisture received as both rainfall and irrigation (Table 5.3). Growing degree days calculated based on air or soil temperatures increased by about 10% from the earliest through to the latest cropping period. The two later cropping periods had very similar air and soil temperature profiles.

In the dryland trial, Ranger Russet consistently out yielded cv Russet Burbank, but the two cultivars responded similarly to the planting/harvest date variable (Table 5.4). Under dryland conditions, planting the crop as early as possible produced the highest yields in all of the yield categories evaluated. The other two planting produced very similar yields and tuber size profiles. The yield advantage observed with the first planting was about 20% and was largely due to the production of 25% more tubers per plant than the other plantings. Average tuber size for the first planting was slightly smaller than for the others.

There was little moisture stress in the dryland trials until August. By this point, the first planting was approaching harvest. By contrast, the two later plantings would have experienced significant periods of drought stress - a fact reflected in the reduced yields.

Table 5.4. Influence of cropping period on yields and tuber size distribution of two potato cultivars - dryland trial (1999).

	Total Yield		Tablestock		Seed		Avg tuber wt.	
Cropping Period	**T/Ha**	**Cwt/a**	**T/Ha**	**Cwt/a**	**T/Ha**	**Cwt/a**	**g**	**oz**
May 14-Aug 24	28.9a[z]	257a	20.5a	183a	28.2a	251a	112b	4.0b
May 27-Sept 10	23.2b	206b	17.0b	151b	23.1b	206b	126a	4.5a
June 4-Oct 1	24.2b	216b	17.1b	152b	23.4b	208b	120ab	4.3ab
Cultivar								
Ranger Russet	27.7a	246a	20.8a	185a	22.9b	204b	129a	4.6a
R. Burbank	23.2b	204b	15.6b	138b	26.9a	239a	111b	4.0b

[z] Values within columns followed by the same letter are not significantly different (p=0.05).

Table 5.5. Influence of cropping period on yields and tuber size distribution of two potato cultivars - irrigated trial (1999).

	Total Yield		Tablestock		Seed		Avg tuber wt.	
Cropping Period	**T/Ha**	**Cwt/a**	**T/Ha**	**Cwt/a**	**T/Ha**	**Cwt/a**	**g**	**oz**
May 14-Aug 24	26.5b [z]	236b	20.6c	183c	25.2c	224c	143b	5.1b
May 27-Sept 10	42.9a	382a	35.6a	317a	42.5a	378a	158a	5.6a
June 4-Oct 1	30.0b	267b	25.4b	226b	30.7b	273b	135b	4.8b
Cultivar								
Ranger	32.1a	286a	27.2a	242a	32.2a	287a	151a	5.4a
R. Burbank	34.1a	303a	27.1a	241a	33.3a	296a	140a	5.0a

[z] Values within columns followed by the same letter are not significantly different (p=0.05).

The dryland trial was grown on a better area of land than the irrigated trial. When the dryland crop was grown with limited drought stress (May14-Aug24), yields on dryland were actually somewhat higher than in the corresponding irrigated trial. Irrigation enhanced yields in the planting periods subject to drought stress (Table 5.5). When drought stress was eliminated, the first period (May 14-Aug 24) actually produced the lowest yields, with the second period (May 27-Sept10) providing the highest yields. The yield differences between the various cropping periods was again largely a function of differing tuber set rather than differences in average tuber size. Under irrigation, Ranger Russet and Russet Burbank produced comparable yields, while in the dryland trial, Ranger Russet consistently outyielded the Russet Burbank. This suggests that Russet Burbank is more responsive to irrigation than Ranger Russet.

Conclusion:

The potential productivity of any planting/harvest date combination is determined by the conditions prevailing during certain key developmental periods. For example, it is crucial to avoid timing tuber set an bulking during periods of drought or heat stress. Unfortunately, weather conditions are inherently unpredictable. **In three years of trials, none of the planting/harvest combinations tested completely avoided problems with adverse conditions at tuber set.** The fact that the highest yielding cropping perio was not consistent across the dryland and irrigated trials suggests that manageable factors such as the availability of moisture have a greater impact on the yield potential of any given cropping period than more fixed characteristics such as temperature or photoperiod. **In situations where soil moisture represents the limiting growth factor, cool conditions are favorable** as they slow water use through evapotranspiration. Delaying planting tends to shift critical development periods into warmer portions of th growing season. Early planted crops may also make better use of soil moisture reserves accumulated from winter snowfall. **When water no longer limits crop growth, cropping periods which feature warmer conditions may increase yields through the promotion of more vigorous growth.** One obvious concern for late planted crops under both dryland and irrigated conditions is the increased potential for damage by insects such as Colorado Potato Beetles and the aphids responsible for spreading viral diseases. Populations of both these types of pest tend to increase as the growing season progresses, placing the late planted crop at increased risk for damage.

Trial 6. Shepody, Atlantic, Alpha and Burbank - Seed Piece Form

Use of whole seed is considered desirable from the viewpoint of reduced disease spread during cutting and greater tolerance of adverse conditions during emergence. Whole seed tends to produce more mainstems /seedpiece which can alter both yields and tuber size distribution. The relative performance of whole versus cut seed can vary between cultivars and can also be influenced by prevailing production conditions. **This study examined the yields and tuber size distribution obtained for four different cultivars using whole versus cut seed. In-row spacings were also varied to determine if the seed-type effect would vary with the overall plant population.** The trial was conducted in 1995-1997. Only the 1997 trial supported **through AFIF funding is discussed in detail.**

The trial was conducted at the Saskatchewan Irrigation Development Centre in Outlook (see above for detailed site description). Elite III single cut, double cut or equivalent size drop seed of Alpha, Atlantic, Shepody or Burbank was planted in late May. The seed was spaced at 15, 20 or 30 cm within the row. There was 1 m between rows. Plots were arranged in factorial RCBD design with four replicates. The trial was irrigated once soil water potentials reached -50 kPa. Standard crop maintenance practices were employed. The crop was harvested at 110 DAP, two weeks after chemical desiccation. The crop was graded as previously described.

Results and conclusions

Yields averaged over the main effects are presented in Table 6.1. As expected, yields increased as the in-row spacing decreased. Overall, the seedpiece form had no effect on yields. However, the different cultivars responded differently to the seed type portions. The highest yields for cv. Alpha were obtained using whole seed. Alpha is a European cultivar selected under conditions where whole seed in the norm. For Atlantics, single cut seed was best while for Shepody and Russet Burbank, planting quarters resulted in the highest yields. The increase in yields with cutting of Shepody and Russet Burbank was unexpected and runs contrary to previous findings.

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Table 6.1. Effects of seed piece form, and within-row spacing on seed and consumption grade tuber yields for selected potato cultivars.

Factor	Level	Seed grade tuber yield		Consumption grade tuber yield	
		t/ha	Cwt./ac	t/ha	Cwt./ac
Cultivar[z]	Alpha	33.2	296	17.3	154
	Atlantic	42.4	378	37	330
	Russet Burbank	41.8	373	30.3	270
	Shepody	37.9	338	35.6	318
Seed form[y]	Whole tuber	39.4	352	30.2	269
	Half	37.7	336	29.2	261
	Quarter	39.4	352	30.7	274
Spacing[x]	15 cm	43.6	389	29.2	261
	20 cm	39.4	352	30.7	274
	30 cm	33.5	299	30.2	269

Analyses of Variance

Source	Significance	
Cultivar	***(3.5)	***(2.2)
Form	NS	NS
Spacing	***(3.0)	*(2.7)
Cultivar x Form	***(6.0)	*(5.5)
Cultivar x Spacing	NS	NS
Form x Spacing	NS	NS
Cultivar x Form x Spacing	NS	NS
C.V. %	19.1	22.4

Table 6.1. Effects of seed piece form, and within-row spacing on seed and consumption grade tuber yields for selected potato cultivars.

Factor	Level	Seed grade tuber yield		Consumption grade tuber yield	
		t/ha	Cwt./ac	t/ha	Cwt./ac
Cultivar[z]	Alpha	33.2	296	17.3	154
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	Shepody	37.9	338	35.6	318
Seed form[y]	Whole tuber	39.4	352	30.2	269
	Half	37.7	336	29.2	261
	Quarter	39.4	352	30.7	274
Spacing[x]	15 cm	43.6	389	29.2	261
	20 cm	39.4	352	30.7	274
	30 cm	33.5	299	30.2	269

Analyses of Variance

Source	Significance	
Cultivar	***(3.5)	***(2.2)
Form	NS	NS
Spacing	***(3.0)	*(2.7)
Cultivar x Form	***(6.0)	*(5.5)
Cultivar x Spacing	NS	NS
Form x Spacing	NS	NS
Cultivar x Form x Spacing	NS	NS
C.V. %	19.1	22.4

Trial 7. Seed Generation Study

As potatoes are grown for progressive generations under field conditions there is usually a progressive accumulation of tuber-borne diseases which can decrease crop vigour and yield potential. Research conducted by the University of Saskatchewan indicates that there are also environmental components that can exert cumulative influences (positive or negative) on seed vigour. The rate of change in seed vigour over generations in the field therefore represents a balance between the stringency of the seed inspection and certification program relative to the intensity of attack by disease vectors or decline associated with adverse environmental conditions. As potato cultivars differ in there tolerance to disease and adverse environmental conditions it could be expected that they would also vary in the rate at which their performance declines through multiple generations n the field. **This study examines the yield potential of various generations of seed potatoes produced under Saskatchewan growing conditions.**

Trials were conducted from 1995 - 1998 at the Saskatchewan Irrigation Development Centre in Outlook (see above for detailed site description). The cultivars and generations tested are outlined below;

Cultivar	1995	1996	1997	1998
Alpha	E1 and E2			E1 and E2
Norland	pre-Elite and E1	E2, E3 and E4	E1, E2 and E3	P.E., E1-3
Ranger	E1 and E2	E2 and E3	E1, E2 and E3	P.E., E1 and E2
Burbank	Pre-Elite and E3		E1, E2 and E3	P.E., E1 and E2
Norkotah	Pre-Elite and bin run			P.E., E1 and E2
Shepody	Pre-Elite and E3	E2 and E3		P.E. and E1
Yukon		E2 and E4	E1, E2 and E3	P.E., E1-3
Viking		E2 and E4	E1, E2 and E3	
Sangre		E3 and E4		

The seed was obtained from local suppliers and cut into uniform lots. The crop was planted in late May, with a 30 cm in-row spacing with 1 m between rows. The trial was irrigated once soil water potentials reached -50 KPa. Standard crop maintenance practices were employed. The trial was harvested in late September, two weeks after chemical desiccation. The crop was graded as previously described. The trial was arranged in a Randomized Complete Block Design with four replicates.

Results:

There were no visible differences in the vigour or disease levels between the various generations tested in any year. The yield data for 1997 and 1998 are presented in Figures 7.1 and 7.2. For most of the cultivars examined, yields were not significantly influenced by 1 to 3 generations in the field. **This indicates that the seed certification program in combination with the favourable environmental conditions characteristic of Saskatchewan helped maintain the vigour of the crop.**

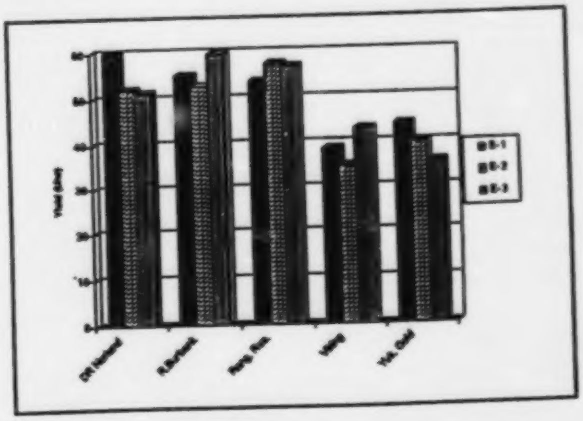

Figure 7.1. **Marketable yields for differing generations of five cultivars of Saskatchewan grown seed potatoes (1997).**

Table 7.2. Seed generation effects on 'seed' grade tuber yield for selected potato cultivars (1998).

Cultivar	Seed generation							
	Pre-Elite		E-1		E-2		E-3	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Alpha	-	-	35.6a	318	44.1a	394	-	-
Norland	50.4a	450	42.1a	376	50.8a	454	51.1a	456
D.R. Norland	56.7b	506	47.8ab	427	45.6a	407	48.3ab	431
Amisk	36.5a	326	47.2b	421	47.5b	424	-	-
R.Burbank	29.0a	259	42.5b	380	39.6ab	354	-	-
R.Norkotah	63.3b	565	56.5ab	505	51.0a	455	-	-
Shepody	39.6a	354	44.8a	400	-	-	-	-
Yukon Gold	44.9a	401	40.5a	362	37.1a	331	36.7a	328
Mean	45.8	409	44.6	398	45.1	403	45.4	405

Values within a column followed by the same letter are not significantly (P<0.05) different.

Table 7.2. Seed generation effects on 'seed' grade tuber yield for selected potato cultivars (1998).

Cultivar	Seed generation							
	Pre-Elite		E-1		E-2		E-3	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Alpha	-	-	35.6a	318	44.1a	394	-	-
Norland	50.4a	450	42.1a	376	50.8a	454	51.1a	456
D.R. Norland	56.7b	506	47.8ab	427	45.6a	407	48.3ab	431
Amisk	36.5a	326	47.2b	421	47.5b	424	-	-
R.Burbank	29.0a	259	42.5b	380	39.6ab	354	-	-
R.Norkotah	63.3b	565	56.5ab	505	51.0a	455	-	-
Shepody	39.6a	354	44.8a	400	-	-	-	-
Yukon Gold	44.9a	401	40.5a	362	37.1a	331	36.7a	328
Mean	45.8	409	44.6	398	45.1	403	45.4	405

Values within a column followed by the same letter are not significantly ($P<0.05$) different.

Section 8. Effects of Soil Moisture Status During Seed Production on the Performance of the Progeny

Previous studies in Europe and North America have shown conflicting results on the productivity of seed potato raised under irrigation and dryland. Some studies showed a positive influence on productivity by irrigating the seed crop and others showed no effect.

This study conducted in 1998 and 1999 examined the mainstem count and productivity for seed potato crop grown without supplemental irrigation, or irrigated at 40% or 65% of Field Capacity. The varieties included in the study were Atlantic, Norland, Russet Burbank, Russet Norkotah, and Shepody. The performance of the seed crop raised at the Outlook site (see above for site description) in 1997 was evaluated in 1998. The performance of the seed crop raised in 1998 was evaluated in 1999. Standard production practices were employed. Yields were evaluated as previously described.

1998 Results

Seed potatoes obtained from dryland produced more mainstems than seed grown under irrigation. The mainstem count decreased with increase in the soil moisture status under which the seed crop was produced (Table 8.1). Norland potato produced the highest number of mainstems. Cultivars responded similarly to change in soil moisture levels when raising the seed crop.

Soil moisture conditions under which the seeds were grown had no effect on yields of seed grade tubers (Table 8.2).

Table 8.1. Effect of soil moisture during seed production on mainstem count of progeny tubers for selected potato cultivars - 1998 trial.

Cultivar	Dryland	40% F.C.	65% F.C.	Mean
Atlantic	2.2	1.9	1.5	1.9
Norland	3	2.8	2.1	2.9
Russet Burbank	1.9	1.7	1.8	1.8
Russet Norkotah	2.5	2.1	2.2	2.3
Shepody	1.9	1.9	1.8	1.9
Mean	2.3	2.1	2	

Analysis of variance

Source	
Cultivar (C)	***(0.2 t/ha)
Irrigation (I)	***(0.1 t/ha)
C x I	NS[1]
CV (%)	11.3

[1] not significant

Values within parentheses are LSD (0.05) estimates for the respective treatments.

Table 8.2. 'Seed' grade tuber yield from seed potato produced under different soil moisture regimes - 1998 trial.

Cultivar	Dryland		40% F.C.		65% F.C.		*Mean*	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Atlantic	56.7	506	51.4	459	53.7	480	53.9	481
Norland	50.7	453	57.5	513	54	482	54	482
R.Burbank	47.6	425	45.2	404	47.8	427	46.9	419
R.Norkotah	56.9	508	62.5	558	53.9	481	57.7	515
Shepody	48.7	435	49	438	48.4	432	48.7	435
Mean	52.1	465	53.1	474	51.6	461		

Analysis of variance

Source	
Cultivar (C)	***(4.0 t/ha)
Irrigation (I)	NS[1]
C x I	NS
CV (%)	9.3

[1] not significant

Values within parentheses are LSD (0.05) estimates for the respective treatments.

1999 Trial

The moisture condition under which the seed crop was raised and the seed piece spacing utilized to grow the crop had no effect on marketable yields of any of the cultivars tested in this trial (Table 8.3).

Conclusions:

Some studies in other countries have shown that the moisture conditions under which seed potato is produced affected the productive potential of the progeny tubers. Our study demonstrated that the productivity of seed potato produced under both dryland and irrigated conditions were similar.

Table 8.2. 'Seed' grade tuber yield from seed potato produced under different soil moisture regimes - 1998 trial.

Cultivar	Dryland		40% F.C.		65% F.C.		*Mean*	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Atlantic	56.7	506	51.4	459	53.7	480	53.9	481
Norland	50.7	453	57.5	513	54	482	54	482
R.Burbank	47.6	425	45.2	404	47.8	427	46.9	419
R.Norkotah	56.9	508	62.5	558	53.9	481	57.7	515
Shepody	48.7	435	49	438	48.4	432	48.7	435
Mean	52.1	465	53.1	474	51.6	461		

Analysis of variance

Source	
Cultivar (C)	***(4.0 t/ha)
Irrigation (I)	NS[1]
C x I	NS
CV (%)	9.3

[1] not significant

Values within parentheses are LSD (0.05) estimates for the respective treatments.

1999 Trial

The moisture condition under which the seed crop was raised and the seed piece spacing utilized to grow the crop had no effect on marketable yields of any of the cultivars tested in this trial (Table 8.3).

Conclusions:

Some studies in other countries have shown that the moisture conditions under which seed potato is produced affected the productive potential of the progeny tubers. Our study demonstrated that the productivity of seed potato produced under both dryland and irrigated conditions were similar.

Table 8.3. Effects of cultivar, irrigation regime, and seed piece spacing of seed crop on yields of consumption grade potatoes produced from that seed.

Treatment		Consumption grade yield (t/ha)
Cultivar:	Atlantic	49.4
	Norland	42.2
	Russet Burbank	33.3
	Russet Norkotah	40.2
	Shepody	51.8
Regime:	Dryland	43.5
	40% F.C.	43.2
	65% F.C.	43.6
Spacing:	15 cm	43
	20 cm	43.9
	30 cm	43.3
Analysis of Variance		
Source:		
Cultivar (C)		***(2.8)
Irrigation (I)		ns
Spacing (S)		ns
C x I		ns
C x S		ns
I x S		ns
C x I x S		ns
C.V. (%)		14.1

*** and ns indicate significance at P<0.001 level of probability and not significant respectively.
Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Trial 9. Effects of Planting Date and Seed Piece Spacing of the Seed Crop on Productivity of the Progeny

Environmental conditions such as temperature and day length influence growth, yields and quality of the crop. They may also influence the performance of the tubers used as seed. This study examined the productive potential of Shepody and Russet Norkotah seed obtained from crops planted at three different times (Mid-May, Late-May, and Early June) and at two seed piece spacings (15 and 30 cm).

The trial was conducted in 1998 and 1999 at the Outlook test site. The 1998 trial was conducted using seed generated in 1997. The 1999 trial was conducted using seed generated in 1998. The seed was stored under standard conditions and planted out in mid-May. The crop was produced using recommended practices for irrigated potatoes. Yield and quality assessments were conducted as previously described.

1998 Results

There were no significant effects of planting date and seed piece spacing of the seed crop on yields of seed grade tubers produced by the progeny (Table 9.1).

Table 9.1. Effect of planting time and seed spacing of the seed crop on 'seed' grade tuber yield of the progeny - 1998 trial.

Treatment	Shepody		Russet Norkotah	
	t/ha	Cwt/ac	t/ha	Cwt/ac
Seed crop planting date[1]				
Early planting	54.2	484	49	438
Mid planting	54.8	489	49.6	443
Late planting	55	491	55.7	497
Seed crop seed spacing[2]				
15 cm	54.7	488	51.1	456
30 cm	54.6	488	51.8	463

Analysis of variance

Source	
Cultivar (C)	NS[3]
Planting date (D)	NS
Seed spacing (S)	NS
C x D	NS
C x S	NS
D x S	NS
C x D x S	NS
CV (%)	11.0

[1] Average of seed piece spacing.
[2] Average of seed planting date.
[3] not significant

Trial 10. Influence of Seed Piece Type and Planting Depth on Productivity of Russet Burbank and Shepody Potatoes

In Saskatchewan, potato planting is done in the spring when the soil temperatures are relatively low. It is possible that emergence would be slow for deeper planted potato compared to shallow planting. It is likely that whole-seed and cut pieces may respond differently to planting depth. This study examined the growth (mainstem count) and productivity of whole and cut seed for Russet Burbank and Shepody potato planted at 15, 20, and 30 cm depths. **Fifteen cm is the standard planting depth recommended for potatoes in Saskatchewan.** The trial was conducted in 1998 and 1999 at the Outlook site and the crop was planted in mid-May. Standard crop production practices were employed. Yields were assessed as previously described.

1998 Results
Spring of 1998 was unusually warm from early April through mid-May. However, in late May, the weather cooled with frost on May 31. The following two weeks were unusually cool and wet. **No significant effects were observed for cultivar or planting depth in relation to yields of seed grade tubers** (Table 10.1). Single-cut seed pieces produced more stems and higher tuber yields than whole-seed. This yield increase was associated with higher tuber numbers for single-cut seed. However, single-cut seed produced smaller tubers than whole-seed.

Table 10.1 Mainstem count and 'seed' grade tuber yield for Russet Burbank and Shepody potato as influenced by seed piece form and planting depth - 1998 trial.

Treatment	Number of mainstems per hill	'Seed' grade tuber yield t/ha	'Seed' grade tuber yield Cwt/ac	Number of tubers per hill	Average tuber weight g
Cultivar[1]					
Russet Burbank	1.6	56.1	501	6.3	247
Shepody	2.1	53.5	478	5.8	255
Seed piece form[2]					
Single cut	2.2	58	518	6.5	245
Whole seed	1.5	51.5	460	5.5	257
Planting depth[3]					
15 cm	1.8	55.2	493	6	251
20 cm	1.8	54.3	485	6	249
30 cm	1.9	54.9	490	6	252
Analysis of variance					
Source					
Planting depth (D)	NS[4]	NS		NS	NS
Cultivar (C)	***	NS		NS	NS
Seed form (F)	***	**		***	***
D x C	NS	NS		NS	NS
D x F	NS	NS		NS	NS
C x F	NS	NS		NS	NS
D x C x F	NS	NS		NS	NS
C.V (%)	14.2	12.8		11.0	9.8

[1]Average of seed piece form and planting depth.
[2]Average of cultivar and planting depth.
[3]Average of cultivar and seed piece form.
[4]not significant

Trial 9. Effects of Planting Date and Seed Piece Spacing of the Seed Crop on Productivity of the Progeny

Environmental conditions such as temperature and day length influence growth, yields and quality of the crop. They may also influence the performance of the tubers used as seed. This study examined the productive potential of Shepody and Russet Norkotah seed obtained from crops planted at three different times (Mid-May, Late-May, and Early June) and at two seed piece spacings (15 and 30 cm).

The trial was conducted in 1998 and 1999 at the Outlook test site. The 1998 trial was conducted using seed generated in 1997. The 1999 trial was conducted using seed generated in 1998. The seed was stored under standard conditions and planted out in mid-May. The crop was produced using recommended practices for irrigated potatoes. Yield and quality assessments were conducted as previously described.

1998 Results

There were no significant effects of planting date and seed piece spacing of the seed crop on yields of seed grade tubers produced by the progeny (Table 9.1).

Table 9.1. Effect of planting time and seed spacing of the seed crop on 'seed' grade tuber yield of the progeny - 1998 trial.

Treatment	Shepody		Russet Norkotah	
	t/ha	Cwt/ac	t/ha	Cwt/ac
Seed crop planting date[1]				
Early planting	54.2	484	49	438
Mid planting	54.8	489	49.6	443
Late planting	55	491	55.7	497
Seed crop seed spacing[2]				
15 cm	54.7	488	51.1	456
30 cm	54.6	488	51.8	463
Analysis of variance				
Source				
Cultivar (C)	NS[3]			
Planting date (D)	NS			
Seed spacing (S)	NS			
C x D	NS			
C x S	NS			
D x S	NS			
C x D x S	NS			
CV (%)	11.0			

[1] Average of seed piece spacing.
[2] Average of seed planting date.
[3] not significant

Trial 10. Influence of Seed Piece Type and Planting Depth on Productivity of Russet Burbank and Shepody Potatoes

In Saskatchewan, potato planting is done in the spring when the soil temperatures are relatively low. It is possible that emergence would be slow for deeper planted potato compared to shallow planting. It is likely that whole-seed and cut pieces may respond differently to planting depth. This study examined the growth (mainstem count) and productivity of whole and cut seed for Russet Burbank and Shepody potato planted at 15, 20, and 30 cm depths. **Fifteen cm is the standard planting depth recommended for potatoes in Saskatchewan.** The trial was conducted in 1998 and 1999 at the Outlook site and the crop was planted in mid-May. Standard crop production practices were employed. Yields were assessed as previously described.

1998 Results

Spring of 1998 was unusually warm from early April through mid-May. However, in late May, the weather cooled with frost on May 31. The following two weeks were unusually cool and wet. **No significant effects were observed for cultivar or planting depth in relation to yields of seed grade tubers** (Table 10.1). Single-cut seed pieces produced more stems and higher tuber yields than whole-seed. This yield increase was associated with higher tuber numbers for single-cut seed. However, single-cut seed produced smaller tubers than whole-seed.

Table 10.1 Mainstem count and 'seed' grade tuber yield for Russet Burbank and Shepody potato as influenced by seed piece form and planting depth - 1998 trial.

Treatment	Number of mainstems per hill	'Seed' grade tuber yield		Number of tubers per hill	Average tuber weight g
		t/ha	Cwt/ac		
Cultivar[1]					
Russet Burbank	1.6	56.1	501	6.3	247
Shepody	2.1	53.5	478	5.8	255
Seed piece form[2]					
Single cut	2.2	58	518	6.5	245
Whole seed	1.5	51.5	460	5.5	257
Planting depth[3]					
15 cm	1.8	55.2	493	6	251
20 cm	1.8	54.3	485	6	249
30 cm	1.9	54.9	490	6	252
Analysis of variance					
Source					
Planting depth (D)	NS[4]	NS		NS	NS
Cultivar (C)	***	NS		NS	NS
Seed form (F)	***	**		***	***
D x C	NS	NS		NS	NS
D x F	NS	NS		NS	NS
C x F	NS	NS		NS	NS
D x C x F	NS	NS		NS	NS
C.V (%)	14.2	12.8		11.0	9.8

[1]Average of seed piece form and planting depth.

[2]Average of cultivar and planting depth.

[3]Average of cultivar and seed piece form.

[4]not significant

1999 Trial:

All cultivars responded alike for the seed form and planting depth effects (Table 10.2). Planting depth had no effect on mainstem number or 'seed' grade yields. The cut seed produced significantly more stems and 'higher seed' yields compared to whole seed (Table 10.2).

Table 10.2. Effects of cultivar, seed form and seeding depth on mainstem number and seed grade yield - 1999

Treatment		Mainstem number per hill	Seed grade yield (t/ha)
Cultivar:	Norland	3.1	45.5
	Russet Burbank	3	46.5
	Russet Norkotah	3	46.5
	Shepody	2.8	49.7
Form:	Whole	2.7	45.5
	Half	3.2	48.6
Depth:	15 cm	2.8	46.5
	22 cm	3.1	47.3
	30 cm	2.9	47.4
Analysis of Variance			
Source:			
Cultivar (C)		ns	*(2.9)
Form (F)		***(0.2)	**(2.1)
Depth (D)		ns	ns
C x F		ns	ns
C x D		ns	ns
F x D		ns	ns
C x F x D		ns	ns
C.V. (%)		20.1	10.7

***, **, * and ns indicate significance at P<0.001, 0.01, 0.05 levels of probability and not significant respectively.
Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Conclusion -

In Saskatchewan, potatoes are planted into relatively cool soils in the spring. Soil temperatures decline with increasing soil depth. Cooler soil temperatures can delay or inhibit emergence leading to seed piece decay, thereby reducing plant stand and negatively affecting yield. This study examined the effects of deeper planting in comparison to the standard 15 cm deep planting. Deeper planting (up to 30 cm) did not affect mainstem density or 'seed' grade tuber yields. This suggests that by the third week in May, the soil was sufficiently warm at the 30 cm depth to avoid the problems associated with excessively cold soils. Whole seed is expected to would perform better than cut seed under adverse conditions ie; cold wet soils. In this study, cut seed outperformed whole seed irrespective of planting depth. These results again suggest that soil temperatures were warm enough at planting time to avoid the problems commonly encountered with deeper planting.

Trial 11. Haulm Covering Study

The main objective in seed potato production is to maximize yields with a focus on relatively small tubers. The number of tuber produced from a hill or mainstem is a function of the number of buried nodes. Post-emergent hilling buries developing stems - in theory this should increase the number of tubers produced by the crop. The number of nodes covered depends on the stage at which hilling is performed.

In 1998 and 1999, this study examined the effect of covering haulms at two stages, 5 cm and 10 cm after emergence compared to the standard practice of not covering for seven potato cultivars with contrasting growth and maturity characteristics. The cultivars included were Alpha, Atlantic, Norland, Russet Burbank, Russet Norkotah, Ranger Russet, and Shepody. This trial was conducted at the Outlook site.

1998 Results:

In the 1998 trial, covering the haulms produced higher yields of seed grade tubers than the standard management practice, irrespective of the cultivar being tested (Table 11.1) . Covering the stems at the 5 cm stage produced 6% higher 'seed' grade yield than the standard practice. The corresponding yield advantage was 10% when haulm covering was per+formed at the 10 cm stage. The yield increase was associated with an increase in tuber number for covering haulms compared to the check treatment.

Table 11.1 Effect of haulm covering stage on yield components of 'seed' grade tubers for selected potato cultivars - 1998 trial.

Treatment	'Seed' grade tuber yield		Tuber number per hill	Average tuber weight, g
	t/ha	Cwt/ac		
Cultivar[1]				
Alpha	47.2	421	13.6	95
Atlantic	53.5	478	4.7	198
Norland	48.8	436	6.8	199
R.Burbank	49.1	438	6.2	217
R.Norkotah	42.5	380	5.2	226
Ranger Russet	39.6	354	4.7	233
Shepody	39.5	353	4.9	219
Haulm cover[2]				
Control	40.7	363	6.3	199
At 5 cm	43.1	385	6.7	196
At 10 cm	44.7	399	6.8	197
Analysis of variance				
Source				
Cultivar (C)	***(3.8 t/ha)		***(0.6 t/ha)	***(14 t/ha)
Haulm cover (H)	**(2.5 t/ha)		**(0.4 t/ha)	NS
C x H	NS[3]		NS	NS
CV (%)	10.8		11.4	8.4

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Haulm cover[2]				
Control	40.7	363	6.3	199
At 5 cm	43.1	385	6.7	196
At 10 cm	44.7	399	6.8	197
Analysis of variance				
Source				
Cultivar (C)	***(3.8 t/ha)		***(0.6 t/ha)	***(14 t/ha)
Haulm cover (H)	**(2.5 t/ha)		**(0.4 t/ha)	NS
C x H	NS[3]		NS	NS
CV (%)	10.8		11.4	8.4

1Average of haulm covering treatment.
[2] Average of cultivar.
[3] not significant

1999 Results:

In the 1999 trial, all cultivars responded similarly to haulm covering treatments (Table 11.2). Haulm covering treatments had minimal but positive impact on tuber yields (Table 11.2).

Table 11.2. Effects of covering haulms and cultivar on seed grade yield - 1999 trial.

Treatment		Seed grade yield (t/ha)
Hilling:	No cover	42.2
	5 cm	42.8
	10 cm	42.6
Cultivar:	Alpha	38.6
	Atlantic	41.9
	Norland	37.8
	Russet Burbank	44.5
	Russet Norkotah	51.1
	Ranger Russet	39.3
	Shepody	44.7
Analysis of Variance		
Source:		
Hilling		ns
Cultivar		**(5.1)
Hilling*Cultivar		ns
C.V. (%)		20.9

***, **, *, and ns indicate significance at P<0.001, 0.01, 0.05 levels of probability and not significant respectively.

Values within parenthesis are LSD (5%) estimates for the corresponding treatments.

Conclusion:

The effects of covering haulms after emergence on 'seed' grade tuber yields were variable during the different years. In one year, the yield response following haulm covering was positive, while in the other season, no response was observed. More work is needed to confirm this phenomenon.

Trial 12. Plant Population and Seed Piece Spacing Uniformity Study

In potato production, plant population and the uniformity of seed piece spacing are critical to maximizing yields and ensuring uniform tuber size distribution. Optimum plant population is a function of the cultivar used and the associated crop production practices including irrigation. Irregular seed spacing can potentially result in highly variable tuber size distribution.

This study conducted in 1997, 1998 and 1999 examined the effects two plant populations (37,000 and 74,000 seed pieces/ha) and three spacing-uniformity treatments (coefficients of variation (CV) of 0%, 32%, 65% for seed piece spacing variability).

Potato seed pieces were spaced at pre-determined intervals to obtain the required variability effects. For example, 0% C.V. contained seed pieces placed at equal distance within the row. The 65% C.V. contained the most irregular seed piece spacings. This study was conducted with Russet Burbank, Russet Norkotah, and Shepody potato under dryland, 40% FC, and 65% soil moisture conditions. Irrigation treatments were applied as described in previous irrigated studies.

1997 Results:

Dryland production produced on the average 18.1 t/ha 'seed' grade tubers (Table 12.1). Soil maintained at 40% FC produced over double the yield than dryland and the soil maintained at 65% FC outyielded the 40% moisture regime by 13%.

Russet Burbank, Russet Norkotah and Shepody responded similarly to plant population and seed piece spacing variability effects under dryland and 65% FC (Table 21.1). Although significant first and second order interactions occurred, there were no identifiable trends on yield in relation to cultivar, plant population and spacing effects (Table 12.1)

Higher plant population produced greater tuber yields than lower population under both 40% and 65% irrigations regimes, whereas both plant densities produced similar yields under dryland (Table 12.1).

Under dryland conditions, uniform spacing produced the higher yields than more variable spacing (Table 12.1). Under 40% irrigation, there was a slight (non-significant) yield reduction with greater spacing variability. All spacing treatments produced similar tuber yields when the crop was provided with abundant moisture (65% FC).

1998 Results:

All cultivars (Russet Burbank, Russet Norkotah, Shepody) responded similarly to the various soil moisture regimes. Favorable rainfall conditions during the growing season resulted in relatively high yields (average 35.3 t/ha) in the dryland plots (Table 12.2). The 40% FC irrigation regime produced, on average, 39% higher 'seed' grade yields than dryland production. Maintaining the soil at 65% FC did not provide any additional yield benefits.

Higher plant population produced higher tuber yields that the low plant population. The corresponding yield advantages was 20% for dryland, 12% for the 40% FC, and 8% for the 65% FC irrigation regimes (Table 12.2).

More uniform seed piece distribution produced significantly higher 'seed' grade tuber yields variable seed piece spacing under both the dryland and irrigated regimes (Table 12.2). The effects of seedpiece spacing variability were not significant under the 65% FC regime.

Table 12.1. Plant population and seed piece distribution effects on seed grade yield for potato cultivars grown under different irrigation regimes in 1997.

Treatment	Yield (t/ha)		
	Dryland	40% F.C.	65% F.C.
Cultivar:			
Russet Burbank	19.1	42.2	45.7
Russet Norkotah	17.1	41.1	47.1
Shepody	18.1	40.4	47.1
Plant Population:			
37,000/ha	17.6	36.1	44.6
74,000/ha	18.6	44.8	49.6
Coeff.. of variation			
0%	19	41.8	48.3
32%	18.2	41.9	47.9
65%	17.2	40	49.1
Analyses of Variance			
Source:			
Cultivar (C)	**(1.3)	ns	ns
Plant Population (P)	ns	***(2.3)	**(3.4)
Coeff. Variation (V)	*(1.3)	ns	ns
C x P	ns	***(3.9)	ns
C x V	ns	ns	ns
P x V	ns	ns	ns
C x P x V	ns	**(6.6)	ns
C.V. (%)	12.1	11.6	15.4

***,**,*, and ns indicate significance at P<0.001,0.01,0.05 levels of probability and not significant respectively.

Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Table 12.2. Plant population and seed piece distribution effects on seed grade yield for potato cultivars grown under different irrigation regimes in 1998.

Treatment	Yield (t/ha)		
	Dryland	40% F.C.	65% F.C.
Cultivar:			
Russet Burbank	33.5	45.3	41.1
Russet Norkotah	40.6	41.7	51.1
Shepody	31.8	44.2	42.2
Plant Population:			
37,000/ha	32.1	41.3	43.1
74,000/ha	38.5	46.2	46.6
Coeff.. of variation			
0%	36.5	47.8	42.6
32%	34.7	44.4	48.1
65%	34.6	39	43.8
Analyses of Variance			
Source:			
Cultivar (C)	***	ns	***
Plant Population (P)	***	*	ns
Coeff. Variation (V)	ns	**	*
C x P	ns	ns	ns
C x V	ns	ns	ns
P x V	ns	ns	ns
C x P x V	ns	ns	ns
C.V. (%)	16.0	17.1	16.5

***,**,*, and ns indicate significance at $P<0.001, 0.01, 0.05$ levels of probability and not significant respectively.
Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

1999 Results

All three cultivars responded similarly to the plant population and seed piece spacing effects under the different moisture regimes (12.3). Irrigated production outyielded dryland production. The 40% FC soil moisture regime produced 13% higher 'seed' grade yields (Table 12.3) than dryland production. The 65% FC soil moisture regime produced 15% higher 'seed' grade yield than dryland.

The higher plant population produced significantly higher 'seed' grade yield than the lower plant population under all moisture regimes (Table 12.3).

Uniform seed piece spacing produced the highest 'seed' grade yields under all three moisture regimes, although the effects were not statistically significant in this trial (Table 12.3).

Table 12.3. Plant population and seed piece distribution effects on seed grade yield for potato cultivars grown under different irrigation regimes in 1999.

Treatment	Yield (t/ha)		
	Dryland	40% F.C.	65% F.C.
Cultivar:			
Russet Burbank	40.5	43.7	47.3
Russet Norkotah	41.1	45.6	47.6
Shepody	41.8	50.3	47.1
Plant Population:			
37,000/ha	38.4	43	43.3
74,000/ha	43.9	50.1	51.3
Coeff.. of variation			
0%	42	47.6	48.6
32%	41.8	47.1	46.8
65%	39.6	45	46.5
Analyses of Variance			
Source:			
Cultivar (C)	ns	***(2.2)	ns
Plant Population (P)	***(1.9)	***(1.8)	***(3.3)
Coeff. Variation (V)	ns	ns	ns
C x P	ns	ns	ns
C x V	ns	ns	ns
P x V	ns	ns	ns
C x P x V	ns	ns	ns
C.V. (%)	9.8	8.2	14.7

***,**,*, and ns indicate significance at P<0.001,0.01,0.05 levels of probability and not significant respectively.
Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Conclusion:
This three-year study confirmed the results presented elsewhere indicating that 'seed' grade potato yields were highest when the crop was grown under irrigation and at a higher plant population. **This study also showed that the highest tuber yields were obtained when the seed pieces were uniformly spaced.** This effect was more pronounced under dryland conditions than when the crop was irrigated. It appears that irrigation was able to compensate yield losses as a result of variable seed distribution.

Trial 13. Effect of Seed Piece Portion on Mainstem Production and Tuber Yield

In a potato tuber, more eyes are located at the apical end as compared to the mid section or basal end of the seed tuber. The apical portion of a potato tuber is therefore likely to develop more mainstems relative to the other parts of the seed-tuber. Potato yields are considered to be a function of mainstem number - a higher mainstem number results in more tubers set and a higher yield potential. Therefore, an apical seed piece is likely to produce higher yields than seed pieces obtained from other parts of a tuber.

This study conducted in 1999 examined the effects of seed piece type (apical, basal, apical + basal) on the mainstem count and tuber yield for Russet Burbank, Russet Norkotah, and Shepody potato. In the apical + basal seed piece type treatment, equal number of apical and basal seed pieces were mixed for field planting.

Results

Seed piece type had no statistically effect on mainstem number or 'seed' grade yields for any of the cultivars tested (Table 13.1).

The crop planted with only apical seed piece produced a slightly higher mainstem number, and tuber yields and the crop established with basal portion alone produced the lowest stem number and tuber yields.

Table 13.1. Effect of cultivar and seed piece type on seed grade yield.

Treatment	Mainstem No. per hill	Seed grade yield (t/ha)
Cultivar: Russet Burbank	2.7	47.9
Russet Norkotah	2.8	45.8
Shepody	2.5	44.8
Form: Apical+Basal	2.6	46.2
Apical	2.9	47
Basal	2.4	45.3
Analysis of Variance		
Source:		
Cultivar	ns	ns
Form	ns	ns
Cultivar*Form	ns	ns
C.V. (%)	20.1	8.2

***, **, *, and ns indicate significance at P<0.001, 0.01, 0.05 levels of probability and not significant respectively.
Values within parenthesis are LSD (5%) estimates for the corresponding treatment.

Trial 14: Ranger Russet, Russet Norkotah, and Shepody: Nitrogen and Phosphorus and Seed Piece Spacing Study

Co-Investigator: T.J. Hogg

Nitrogen and phosphorus are the most commonly limiting nutrients for potato production. Proper fertility management is critical, particularly under the relatively short growing seasons available to Saskatchewan seed growers. Excess nitrogen can delay maturity, making harvesting difficult and impairing the storage potential of the crop. Delayed maturity can also negatively affect the quality of seed potatoes. It is likely that the nitrogen and phosphorus requirement of potato may vary depending on the cultivars, moisture availability and for different plant populations.

This study examined the interactive effects of four levels of nitrogen (50, 100, 150, 200 kg N/ha), two levels of phosphorus (60, 120 kg P_2O_5/ha), two seed piece spacings (15, 30 cm) for Ranger Russet, Russet Norkotah, and Shepody potato. At present, the standard recommendation for the production or irrigated potatoes in Saskatchewan is 120 kg/ha of P2O5 and 175-200 kg/ha of N.

1997 Results:

Spring soil analyses indicated residual levels of 30 kg NO_3-N/ha, 26 kg P_2O_5/ha and 1000 kg K_2O/ha in the 0-30 cm horizon prior to planting.

Nitrogen application had a positive influence on 'seed' grade tuber yields for all the cultivars tested but statistically significant differences were observed only for Shepody (Table 14.1). 'Seed' grade yields plateaued at 100 kg N/ha for Ranger Russet and Shepody, whereas, Russet Norkotah yields peaked at 150 kg N/ha. There were no indications of any negative effects of excess N levels on tubers yields in this trial.

Shepody responded positively to the addition of 120 kg P_2O_5/ha, i.e. applying 120 kg P_2O_5/ha produced approximately 8% higher 'seed' grade yield than 60 kg P_2O_5/ha (Tables 14.1). The other cultivars performed well at the lower P level.

Increasing the plant population by reducing seed piece spacing from 30 cm to 15 cm increased 'seed' grade tuber yield by 23% for Ranger Russet, 15% for Russet Norkotah, and 27% for Shepody (Table 14.1). The fertility requirements of the cultivars tested was not influenced by the plant population.

1998 Results:

Pre-plant soil analysis indicated residual levels of 39 kg, 32 kg, and 620 kg respectively of N, P, and K at 0-30 cm.

For Ranger Russet and Russet Norkotah, yields again peaked around 150 kg N/ha. Shepody responded positively to increasing nitrogen application up to 200 kg N/ha.

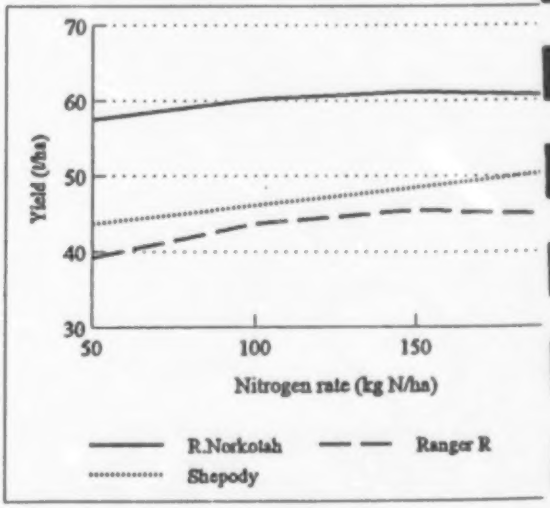


Figure 14.1. 'Seed' grade yield response of potato cultivars to nitrogen application: 19

Table 14.1. Nitrogen, phosphorus, and seed piece spacing effects on seed grade tuber yield for Ranger Russet, Russet Norkotah, and Shepody potato grown under irrigation: 1997

		Seed grade tuber yield (t/ha)		
Factor	Level	Ranger Russet	Russet Norkotah	Shepody
Nitrogen (kg N/ha)[z]	50	47.3	52.1	52.5
	100	49.8	54.4	58.1
	150	49.7	59.5	58.1
	200	46.9	57.1	59.5
Phosphorus (kg P_2O_5/ha)[y]	60	47.3	55	54.9
	120	49.5	56.5	59.3
Seed piece spacing (cm)[x]	15	53.4	59.7	63.9
	30	43.5	51.9	50.3
Analyses of Variance				
Source				
Nitrogen		NS	NS	**(4.1)
Phosphorus		NS	NS	**(2.9)
Spacing		**(3.6)	**(4.3)	**(2.9)
Nitrogen x Phosphorus		NS	**(8.6)	NS
Nitrogen x Spacing		NS	NS	NS
Phosphorus x Spacing		NS	NS	NS
Nitrogen x Phosphorus x Spacing		NS	NS	NS
C.V. (%)		14.8	15.3	9.9

[z] Average of phosphorus and seed piece spacing.
[y] Average oh nitrogen and seed piece spacing.
[x] Average of nitrogen and phosphorus.
Values within parentheses are LSD (5.0%) for the different treatments.

Only Shepody responded positively to phosphorus application above 60 kg/ha (Table 14.2). This corresponds to the results obtained in 1997.

The 15 cm seed piece spacing produced significantly higher yields than the 30 cm spacing for all three cultivars. The yield superiority with closer seed spacing over the wider spacing was 24% for Russet Norkotah, 33% for Ranger Russet, and 25% for Shepody (Table 14.2).

1999 Results:
Spring soil analysis results for the various tests are summarized in Table 14.3.

'Seed' grade yields plateaued at 100 kg N/ha for Ranger Russet, at 150 kg N/ha for Shepody, and at 200 kg N/ha for Russet Norkotah (Table 14.4). The greatest benefit in terms of increased yield/unit N applied was obtained up to 100 kg N/ha for all cultivars. Nitrogen application in excess of 100 kg N/ha produced non-significant yield increases.

Table 14.2. Phosphorus and seed piece spacing effects on seed grade yield for selected french fry potato cultivars: 1998

Treatment	Seed grade yield (t/ha)		
	Russet Norkotah	Ranger Russet	Shepody
Phosphorus (kg P_2O_5/ha)[z]			
60	59.7	43.7	45
120	60	42.9	50
Seed piece spacing (cm)[y]			
15	66.2	49.3	52.4
30	53.6	37.1	42
Analyses of Variance			
Source:			
Nitrogen (N)	ns	**	ns
Phosphorus (P)	ns	ns	*
Spacing (S)	***	***	***
N x P	ns	ns	ns
N x S	ns	ns	ns
P x S	ns	ns	ns
N x P x S	ns	ns	ns
C.V. (%)	9.9	11.4	18.8

[Z] Average of nitrogen and seed piece spacing.

[Y] Average of nitrogen and phosphorus.

Table 14.3. Spring soil nutrient levels at 30 cm depth for the different nitrogen x phosphorus tests in 1999

Nutrient	Shepody	Ranger Russet	Russet Norkotah
	Nutrient level kg/ha		
Nitrogen (N)	37	44	54
Phosphorus (P)	16	24	28
Potassium (K)	632	696	688

Applying 120 kg P_2O_5/ha produced significantly higher 'seed' grade yields relative to 60 kg P_2O_5/ha for Shepody and Ranger Russet potato (Table 14.4). There was no added advantage to the higher level of phosphorus application for Russet Norkotah.

Increasing plant population by decreasing seed piece spacing produced significantly higher 'seed' grade for all cultivars (Table 14.4). This yield advantage was 9% for Shepody, 13% for Ranger Russet, and 14% for Russet Norkotah.

The nitrogen x spacing interactions were significant for 'seed' grade yields for Russet Norkotah (Table 14.4, Figure 2). At a 30 cm seed piece spacing, 'seed' grade yields peaked at 150 kg/ha applied nitrogen. When the plants were more closely spaced, more N (200 kg/ha) was required to reach the yield maximum.

Table 14.4. Nitrogen, phosphorous, and seed piece spacing effect on mainstem count for and seed grade yield for Shepody, Ranger Russet, and Russet Norkotah potatoes: 1999

Treatment		Seed grade yield (t/ha)		
		Shepody	Ranger Russet	Russet Norkotah
Nitrogen (kg N/ha):	50	45.6	44.2	46.6
	100	50.7	47.6	49.8
	150	52.9	46.7	50
	200	51	46.6	50.2
Phosphorous (kg P_2O_5/ha):	60	49.1	45.1	49
	120	51	47.5	49.3
Spacing (cm):	15	52.2	49.2	52.3
	30	47.9	43.4	46
Analyses of Variance				
Source:				
Nitrogen (N)		***(2.4)	*(2.1)	**(2.1)
Phosphorous (P)		*(1.7)	**(1.5)	ns
Spacing (S)		***(1.7)	***(1.5)	***(1.5)
N x P		ns	ns	ns
N x S		ns	ns	***(3.0)
P x S		ns	ns	ns
N x P x S		ns	ns	**(4.2)
C.V. (%)		6.7	6.3	6.0

***, **, *, and ns indicate significance at P<0.001, 0.01, 0.05 levels of probability and not significant respectively.
Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Conclusion:

This studies was conducted on a low fertility sandy soil - therefore the growth and yield responses likely reflect responses to the applied nutrients rather than any residual nutrients. The crops were also grown under irrigation with all other aspects of crop growth intensively managed. The yields therefore represent near the maximum possible for this region.

Fertility responses varied somewhat over the three years of this study but the following generalizations could be made.

- A minimum of 100 kg N/ha was required for good yields for all cultivars.
- Yields of Russet Norkotah and Shepody plateaued around 150 kg N/ha, while Ranger Russet required less N. Ranger is a highly vigorous, late maturing cultivar. Top-killing Ranger is notoriously difficult. The results of this trial suggest that this problem may stem from the growers applying excessive amounts of N to this variety. By comparison, Shepody and especially Russet Norkotah have a relatively less vigorous growth habit and are earlier maturing. This may explain why these varieties responded positively to the higher rates on N.
- Excessively high rates of N had no negative impact on yields and therefore only represent a financial liability.

- Shepody consistently produced higher yields at 120 kg P_2O_5/ha applied phosphorus, while 60 kg P_2O_5/ha was sufficient for Ranger Russet and Russet Norkotah. It is noteworthy that 120 kg/ha is the standard recommendation for P2O5 for irrigated potatoes.
- Higher plant populations produced higher 'seed' grade yields for all three cultivars. Plant populations only rarely had any impact on the fertility requirements of the crop.

Trial 15: **Russet Burbank and Russet Norkotah: Nitrogen Source, Rate and Time of Application Effects**

Co-Investigator: T. J. Hogg

Previous studies in Europe and U.S.A have shown differential response to nitrogen fertilizer sources in potato production. This study examined the effects of Urea and Ammonium sulphate on yield of 'seed' grade potato for Russet Burbank (late-season, indeterminant) and Russet Norkotah (mid-season, determinant) potato. This test utilized three nitrogen rates (100, 200, 400 kg N/ha; i.e.90, 180, 360 lb N/ac) and two methods of application (all at planting and planting + hilling). The trials were conducted at CSIDC using the crop management and yield evaluation techniques previously described.

1998 Results:

Table 15.1. Nitrogen source, rate and time of application effects on seed grade tuber yield for Russet Burbank and Russet Norkotah potato:1998

Treatment	Seed grade yield (t/ha)	
	Russet Burbank	Russet Norkotah
Nitrogen source[z]		
Amm. Sulphate	44	59.9
Urea	41.3	58.1
Nitrogen rate (kg N/ha)[y]		
100	44	58.1
200	43.6	60.7
400	40.3	58.1
Application time[x]		
At planting	42.1	56.9
At planting & hilling	43.1	61.1
Analysis of variance		
Source		
Source (S)	ns	ns
Rate (R)	ns	ns
Application (A)	ns	**
S x R	ns	ns
S x A	ns	ns
R x A	ns	ns
S x R x A	ns	*
C.V (%)	15.9	8.5

[z] Average of nitrogen rate and time of application.

[y] Average nitrogen source and time of application.

[x] Average of nitrogen source and rate.

Pre-plant soil analysis indicated 38 kg, 29 kg, and 499 kg respectively of N, P, and K at 0-30 cm depth in the trial area.

Nitrogen source, rate, or application method had no effect on 'seed' grade yield for Russet Burbank (Table 15.1). However, Russet Norkotah produced significantly (7%) higher yields when nitrogen was applied in a split applications (planting + hilling) rather than at planting alone (Table15.1). Russet Norkotah did not respond to either nitrogen source or rate of application.

1999 Results:

The pre-plant soil analysis for the 1999 test site are summarized in Table 15.2.

Ammonium sulphate produced higher 'seed' grade yields for all cultivars than the urea (Table 15.3). This yield advantage was 7% for Norland, 5% for Russet Burbank, and 13% Russet Norkotah (Table15.3).

Table 15.2. Spring soil nutrient levels at 30 cm depth for the nitrogen source tests in 1999.

Nutrient	Norland	Russet Burbank	Russet Norkotah
	Nutrient level kg/ha		
Nitrogen (N)	42	43	37
Phosphorus (P)	15	10	13
Potassium (K)	644	520	492

Nitrogen rates from 100 to 400 kg N/ha had no effect on tuber yields (Table 15.3). Applying nitrogen all at planting or split-applied at planting and at hilling produced similar yields (Tables 15.3)

For Russet Norkotah, the responses to nitrogen rates were different for the two nitrogen sources (Figure 15.1). With ammonium sulphate, tuber yields were comparable from 100 to 400 kg N/ha but yields were adversely affected by very high rates of urea.

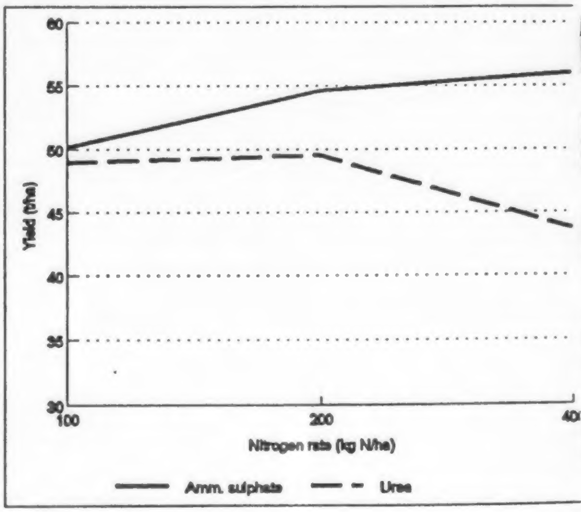


Figure 15.1. Effects of nitrogen source and rate of application in 'seed' grade yield for Russet Norkotah.

Conclusion:

The rate of N applied, the form it was applied in and the timing of the N application had very little effect on yields of either of the potato cultivars tested in this trial. This suggests that potatoes are quite tolerant of differing N management practices.

Table 15.3. Nitrogen source, rate and timing effects on seed grade yield for Norland, Russet Burbank, and Russet Norkotah potatoes: 1999

Treatment		Seed grade yield (t/ha)		
		Norland	Russet Burbank	Russet Norkotah
N source:	Ammonia	53.9	47.8	53.6
	Urea	50.3	45.5	47.4
N rate (kg N/ha):	100	50.6	45.4	49.5
	200	51.6	48.2	52
	400	54.1	46.2	49.9
Timing:	P	52.2	46.1	50.4
	P+H	51.9	47.2	50.5
Analyses of Variance				
Source:				
N Source (S)		ns	*(2.1)	***(3.6)
N Rate (R)		ns	ns	ns
N Timing (T)		ns	ns	*(6.2)
S x R		ns	ns	ns
S x T		ns	ns	ns
R x T		ns	ns	ns
S x R x T		ns	ns	
C.V. (%)		12.2	7.7	12.0

***, *, and ns indicate significance at P<0.001, 0.05 levels of probability and not significant respectively.
Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Trial 16: **Ranger Russet, Shepody and Russet Norkotah: Split Application of Nitrogen**

Co-Investigator: T.J. Hogg

Rate and timing of nitrogen application is extremely important in potato production; particularly in areas with a short growing situation such as Saskatchewan. It is likely that early and late maturing cultivars wil respond differently to nitrogen application. This study examined the effect of split applying 150 and 200 kg N/ha for late maturing processing potato cvs. Ranger Russet and Shepody in comparison to relatively early maturing Russet Norkotah (table potato). The different split applications included (i) all N at planting (P), and equal splits at (ii) planting and hilling (P+H), (iii) planting, hilling and three weeks after hilling(P+H+3), and (iv) planting, hilling, three and five weeks after hilling (P+H+3+5). This trial was conducted under irrigation at CSIDC utilizing the crop management and yield evaluation methods previously described.

1997 Results:

For all the cultivars tested, the nitrogen rate and the various split application treatments had no effect on 'seed' grade tuber yields (Table 16.1).

Table 16.1. Rate and timing of Nitrogen application on seed grade tuber yield for Ranger Russet, Russet Norkotah, and Shepody potato grown under irrigation: 1997

Factor	Level	Seed grade (t/ha)
Cultivar[z]	Ranger Russet	59.6
	Russet Norkotah	59.1
	Shepody	59.7
N rate (kg N/ha)[y]	150	58.9
	200	60
Application time[x]	P	61.4
	P+H	59.9
	P+H+3	58.5
	P+H+3+5	58
Analysis of Variance		
Source		**Significance**
Cultivar		NS
Rate		NS
Timing		NS
Cultivar x Rate		NS
Cultivar x Timing		NS
Rate x Timing		NS
Cultivar x Rate x Timing		NS
C.V. (%)		13.2

[z] Average of nitrogen rate and time of application.
[y] Average of cultivar and time of application.
[x] Average of cultivar and nitrogen rate.

1998 Results:

Again, there were no significant yield response to nitrogen rate or timing of application for any of the cultivars tested (Table 16.2).

Table 16.2. Effect of time of application of nitrogen fertilizer on seed grade tuber yield for selected potato cultivars: 1998

Time of application	Seed grade yield (t/ha)			
	R. Norkotah	Ranger R	Shepody	*Mean*
Planting	65.5	49	51.5	*54.6*
Plant.+Hill	67.8	54.6	56	*59.4*
Plant+Hill+3w	63.8	54.6	56.2	*58.2*
Plant+Hill+3w+2w	63.2	54.5	57.7	*58.5*
Mean	*64.6*	*53.2*	*55.4*	

Analysis of variance	
Source	
Cultivar (C)	***(3.2)
Rate (R)	ns
Application (A)	ns
C x R	ns
C x A	ns
R x A	ns
C x R x A	
C.V (%)	11.1

Value within parenthesis is LSD (0.05) estimate for the respective treatment.

1999 Results:

Spring soil analysis at the test site indicated residual levels of 69 kg N/ha, 18 kg P/ha, and 904 kg K/ha at a depth of 30 cm.

Shepody produced highest and Russet Norkotah the lowest 'seed' grade tuber yields (Table 16.3). The highest yield was obtained with 150 kg N/ha.

A significant cultivar x timing interaction was observed for 'seed' grade yield (Table 16.3). However, no agronomically coherent trends were evident to this interaction effect (Figure 16.1).

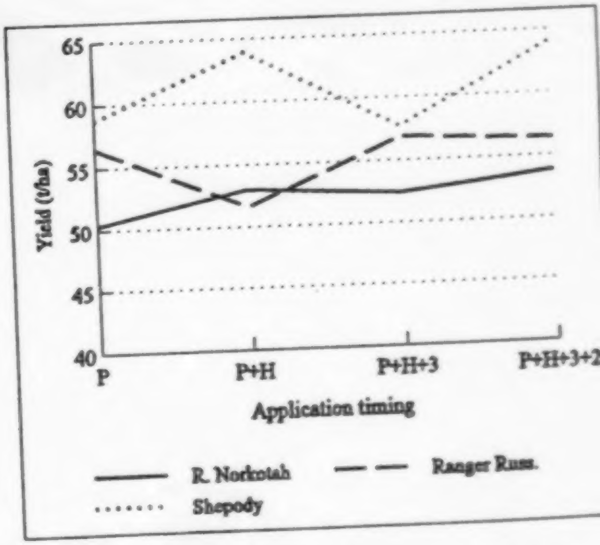


Figure 16.1. Seed grade yield response to timing of nitrogen application for different potato cultivars.

Table 16.3. Effects of split application of nitrogen on seed grade yield or Russet Norkotah, Ranger Russet, and Shepody potatoes: 1999

Treatment		Yield (t/ha)
Cultivar:	Russet Norkotah	52.4
	Ranger Russet	55.3
	Shepody	61.1
Nitrogen rate (kg N/ha)	150	58.6
	200	55.1
	400	55.2
Timing:	P	55.2
	P+H	56.2
	P+H+3	55.7
	P+H+3+2	58.1
Analysis of Variance		
Source:		
Cultivar (C)		***(2.6)
Nitrogen rate (R)		*(2.6)
Timing (T)		ns
C x R		ns
C x T		*(5.1)
R x T		ns
C x R x T		ns
C.V. (%)		11.3

***, *, and ns indicate significance at P<0.001, 0.05 levels of probability and not significant respectively.

Values within parentheses are LSD (5.0%) estimates for the corresponding treatments.

Conclusion:

This study showed that there was no advantage in split applying nitrogen fertilizer. Nitrogen applied all at planting or split applied, at planting and at hilling, was suitable. As observed in previous studies, application of nitrogen in excess of 150 kg N/ha was not beneficial.

Trial 17: Potassium Source and Rate Study For Norland and Russet Burbank

Co-Investigator: T.J. Hogg

Saskatchewan soils have high native levels of potassium. Studies in the USA have shown that potato responds positively to high levels of K and to different sources of potassium fertilizer. The benefits of applied K are greatest when the nutrient is available to support early crop development. This study examined the effects potassium sulphate and potassium chloride as potassium sources for the production of a number of potato cultivars.

1997 trial.

Four rates of potassium fertilizer (100, 200, 300, 400 kg K_2O/ha) were studied in comparison to a check treatment (no added potassium). The test cultivars were Russet Burbank and Norland. Spring soil analyses at the test site indicated that 30 kg NO_3-N/ha, 26 kg P_2O_5/ha, 1000 kg K_2O/ha was present at 0-30 cm (0"-12")depth. Potassium recommendation for irrigated potatoes in Saskatchewan are 500 kg/ha.

Results:
The source and rates of potassium had no effect on 'seed' grade tuber yields for either Norland or Russet Burbank (Table 17.1).

Table 17.1. Potassium source and rate effects on seed grade tuber yield for Norland and Russet Burbank potato: 1997

Factor	Level	Seed grade tuber yield (t/ha)	
		Norland	Russet Burbank
K source[z]	Sulphate	59	59.4
	Chloride	60.7	58.8
K rate (kg K_2O/ha)[y]	0	55.6	58.8
	100	55.3	57.9
	200	56.1	61.1
	300	62	57.8
	400	60.9	59.6
Analyses of Variance			
Source			
K Source		NS	NS
Rate		NS	NS
K source x Rate		NS	NS
C.V.(%)		18.8	8.1

[z] Average of rates.
[y] Average of sources.

1998 Results:
This study examined the effects of two sources of potassium (potassium chloride and potassium sulphate), and three rates (50, 100, 200 kg K_2O/ha) for Russet Burbank, Ranger Russet, and Shepody potato. Spring soil analysis of the test site indicated 80 kg, 39 kg, and 440 kg respectively of N, P, and K at 0-30 cm depth.

The source and rate of potassium application had no effect on seed' grade tuber yield for Ranger Russet o Shepody (Table 17.2). The significant source x rate interaction for 'seed' grade yield of Russet Burbank indicates that higher rates of potassium sulphate decreased yields while high rates of potassium chloride di not affect tuber yields (Figure 17.1). It is possible that the yield reduction for higher rates of potassium sulphate is due sulphate toxicity. Additional work is needed to confirm this phenomenon.

Table 17.2. Potassium source and rate effects on seed grade tuber yield for selected french fry potato cultivars: 1998

Treatment	Seed grade yield (t/ha)		
	Russet Burbank	Ranger Russet	Shepody
Potassium source[z]:			
Chloride	36.6	40.4	45.3
Sulphate	38.4	41.1	49.9
Potassium rate (kg K_2O/ha)[y]:			
50	35.7	40.3	46
100	38.9	40.4	45.3
200	38	41.5	45.6
No potassium check	37.4	36.7	39.9
Analysis of variance			
Source			
Source	ns	ns	ns
Rate	ns	ns	ns
Source x Rate	*(4.8)	ns	ns
C.V. (%)	9.3	13.2	9.9

[z] Average of potassium rates.

[y] Average of potassium source.

Value within parenthesis is LSD (0.05) estimate for the respective treatment.

1999 Trial

This study examined the requirement of supplementary potassium for production of contrasting french fry cultivars such as Russet Burbank, Ranger Russet, and Shepody. The fertilizer treatments included two potassium sources (potassium chloride, potassium sulphate) and three rates of application (50, 100, 200 kg K_2O/ha). Potassium was applied all at planting. Spring soil analysis results for the various tests are summarized in Table 17.3.

Potassium chloride produced significantly (8%) higher 'seed' grade yield than potassium sulphate for Russet Burbank, while the potassium source had no effect on tuber yields for Ranger Russet or Shepody (Table 17.4 and Figure 17.1).

All three cultivars responded positively to increase potassium application although the treatment effects were significant only for Ranger Russet (Table 17.4). Applying 200 kg K_2O /ha produced 11% higher 'seed' grade yield than 50 kg K_2O/ha.

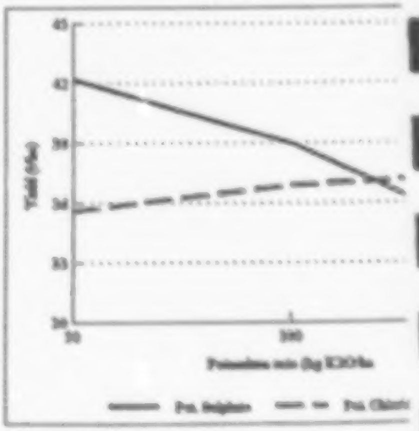


Fig. 17.1. Potassium source and ra on 'seed' grade tuber yield for Rus Burbank potato.

Table 17.3. Spring soil nutrient levels at 30 cm depth for the potassium tests: 1999

Nutrient	Russet Burbank	Ranger Russet	Shepody
	Nutrient level kg/ha		
Nitrogen (N)	46	44	47
Phosphorus (P)	17	16	20
Potassium (K)	556	524	580

Table 17.4. Potassium source and rate effects of seed grade yield of Russet Burbank, Ranger Russet, and Shepody potato: 1999

Treatment		Seed grade yield (t/ha)		
		Russet Burbank	Ranger Russet	Shepody
Source	Chloride	50.3	44.1	42.4
	Sulphate	46.8	43.9	45
Rate (kg K_2O/ha):	50	47.2	41.6	42.7
	100	48.5	44.4	43.8
	200	50.1	46.1	44.6
Analyses of Variance				
Source:				
Source (S)		**(2.2)	ns	ns
Rate (R)		ns	*(3.4)	ns
S x R		ns	ns	ns
C.V. (%)		5.2	7.3	17.2

**, *, and ns indicate significance at P<0.01, 0.05 levels of probability and not significant respectively. Values within parentheses are LSD (5%) estimates for the corresponding treatments.

Conclusion:
This three-year study did not provide any clear indications regarding the need for supplemental potassium or different potassium sources. This likely reflects the K rich status of Saskatchewan soils. It also reflects the potato crops tolerance for very high levels of K.

Section 2. Agronomy of New Potato Cultivars

Project Background.

Changes in market demand, pest pressure and other factors drive the requirement for new varieties of all crops. In potato production, growers are looking for new varieties with higher or more consistent yields with lower grade-out combined with superior keeping and processing quality. The Saskatchewan Seed Potato Growers Association (SSPGA) is part of the Prairie Potato Breeding Consortium which is responsible for the development and release of new varieties suited to Prairie growing conditions and market requirements. Each year, new releases are made available to consortium members for testing prior to licencing. A component of this testing program involves evaluating the cultivars response to management practices. **This section of this report deal with the agronomic trials conducted on the newly released lines selected by the SSPGA for pre-licencing evaluation in 1997 through 1999.**

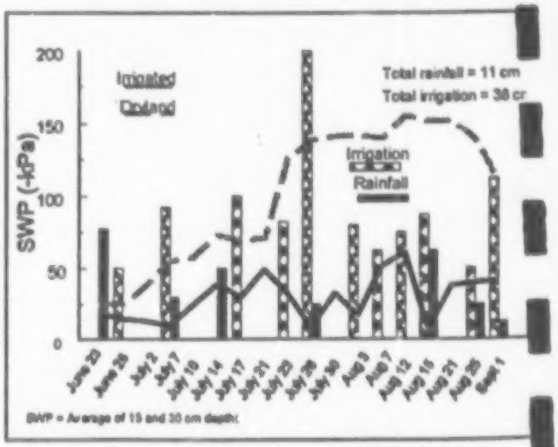
Trial 1. NorDonna Agronomics

NorDonna is a newly released (North Dakota Breeding Program) red skinned table variety. Saskatchewan's table potato industry is interested in NorDonna as a potential replacement for Norland which tends to lose color during storage. There is a concern that NorDonna may be slow maturing and lack the yield potential of Norland. Plant populations (seedpiece spacing) has a strong influence on yields, tuber size distribution and rate of maturity in potatoes. The optimum plant population for any variety depends on management factors with the availability of soil moisture being the most common limiting factor in Saskatchewan's seed industry.

This trial evaluated the impact of seedpiece spacing on yields of NorDonna under irrigated and dryland conditions.

The trial was conducted in 1997 at the University of Saskatchewan Potato Field Research Station (see above for detailed site description and production practices). Elite II whole seed was planted at 17, 26, 35 and 52 cm in-row spacings in mid-May. Between row spacing was 1 m. Half of the plot was irrigated once soil water potentials reached -50 kPa, while the other half of the trial was managed without irrigation. Soil moisture potentials averaged over the top 30 cm in 1997 are presented in Figure 1.1. Total rainfall over the growing season was 11 cm. while the total moisture applied as irrigation was 38 cm.

Figure 1.1. Soil water potentials for irrigated and dryland trials in Saskatoon in 1997.



Results

The 1997 growing season was exceptionally long, with excellent growing conditions throughout. Yields in 1997 should represent the optimum expected for Saskatchewan. The NorDonna crop canopy was more uniform than Norland but was slower to establish. While the Norland crop had senesced by early September, the NorDonna crop was still growing vigorously at the time of top kill in mid-September.

Yields and tuber size distribution were similar for the various in-row spacings tested when the crop was grown under dryland conditions (**Figure 1.2**). Yields on dryland were, on average, only 26% lower than when the crop was irrigated. This suggests that NorDonna is relatively drought tolerant, as rainfall was limited during the 1997 cropping season. When the crop was irrigated, yields in all tuber size categories increased as the in-row spacing decreased. Yields of marketable size tubers for the closest in-row spacing (17cm) were 35% higher than when the crop was grown at 52 cm (20") spacings. NorDonna does not produce as many oversize tubers as Norland and spacing had little impact on the proportion of the crop fitting into the oversize category. Yields of NorDonna were lower than Norland at equivalent in-row spacings, but when planted very close together, the NorDonna produced yields comparable to Norland.

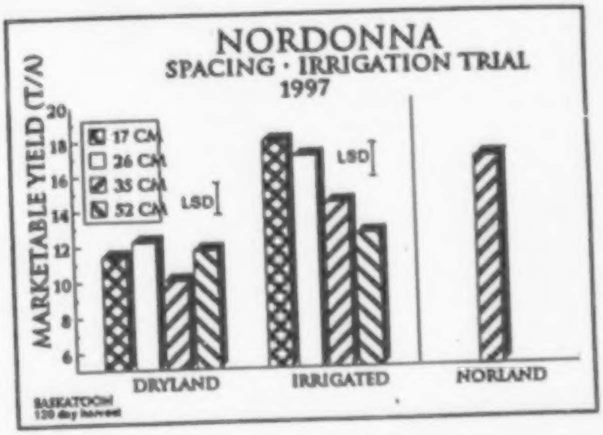


Figure 1.2 Marketable yields for NorDonna as influenced by irrigation practices and in-row spacings.

Recommendations based on a single season of data at one site are risky. However, this trial suggests;

Under Dryland conditions - ***NorDonna produces relatively well, with uniform yields and tuber size distribution irrespective of seedpiece spacing.***

Under Irrigated conditions - ***NorDonna responds best to close in-row spacing. Tuber size distribution is not influenced by plant populations.***

Trial 2. Agronomics of New Red-Skinned Cultivars;

Plant populations (seedpiece spacing) has a strong influence on yields, tuber size distribution and rate of maturity in potatoes. The optimum plant population for any variety depends on management factors with the availability of soil moisture being the most common limiting factor in Saskatchewan's seed industry.

This trial evaluated the impact of seedpiece spacing (15, 25 and 35 cm = 6, 10 and 14") on the yields and tuber size distribution of the standard red-skinned cultivar Norland, along with newly released red lines (NorDonna, Cherry Red and VO498-1) under irrigated and dryland conditions.

Cultivars characteristics;

Norland -	is the standard red skinned variety on the Canadian Prairies. It is early maturing with excellent yields of fairly uniform tubers. Norland tends to fade from red to pink during storage.
NorDonna -	is a newly released North Dakota variety with very dark red skin. NorDonna is slow maturing and may lack the yield potential of Norland.
Cherry Red -	this Colorado variety is exceptionally red and holds its color well. This variety may be too slow maturing for local growing conditions.
VO 498-4 -	is a new release from the potato breeding program at Agriculture Canada Lethbridge. This variety has produced excellent yields of very uniform tubers under irrigated conditions but had performed poorly under drought stress.

Trials were conducted in 1998 and 1999 on the Plant Sciences Potato Research plots located in Saskatoon utilizing standard production practices for commercial potatoes. The crop was seeded in mid-May in rows 90 cm apart. Irrigated plots were watered once soil water potentials rose above -60kPa. Typically, 2.5 cm of water was applied at each irrigation event. The dryland plots relied solely on rainfall. Yields were evaluated at 90 and 120 days after planting. At both harvests, the crop was graded into size categories; small = < 44 mm diam., 44 < medium < 88 mm and oversize = > 88 mm diam. Table stock yields included the medium and oversize categories while the seed category included the pooled yield of small and medium size tubers.

1998 Results - The crop canopy for cv. NorDonna was more uniform than Norland but was slower to establish. While the Norland crop had senesced by early September, the NorDonna crop was still growing vigorously at top kill in mid-September. The growth habit of Cherry Red was intermediate between the two other cultivars. **The Norland crop canopy in the dryland plots was substantially larger than for the other two cultivars - suggesting greater drought tolerance.**

Yields under irrigation exceeded those on dryland by a factor three fold averaged over the three cultivars and two harvest dates (Table 2.1). Norland was the highest yielding cultivar irrespective of harvest date or availability of moisture. NorDonna performed poorly while Cherry Red was intermediate between Norland and NorDonna. Increasing the plant population by reducing the in-row spacing had little effect on yields when moisture was limiting. When moisture was abundant, yields progressively increased as the in-row spacing narrowed.

Table 2.1 Yields and tuber size distribution of three red skinned potato cultivars at 90 and 120 days after planting under irrigated and dryland conditions

	Tablestock (t/ha)				Seed (t/ha)				Avg. Tuber Wt. (g)			
	15 cm	25 cm	35 cm	L/Q	15 cm	23 cm	35 cm	L/Q	15 cm	25 cm	35 cm	L/Q
EARLY HARVEST - 90 days												
DRYLAND												
Cherry Red	8.1	8.3	7.6	NS/NS	12.5	11.3	11.6	NS/NS	72	118	78	Q
Norland	13.2	10.5	8.8	NS/NS	19.9	16.1	13.1	L	82	81	76	NS/NS
Nordonna	0.2	1.9	0.9	NS/NS	2.4	4	4.6	NS/NS	29	56	34	NS/NS
LSD 0.05	4.9	4.9	6.5		5.3	5.8	7.3		13	55	28	
IRRIGATED												
Cherry Red	39.2	34.6	31.2	L	39.8	31.5	27.5	L	166	182	204	L
Norland	50.5	54.8	43.3	Q	48	45.9	34.4	L,Q	185	208	210	L
Nordonna	16.9	11.7	14.8	NS	22.8	17.4	18.4	NS	116	78	106	Q
LSD 0.05	5.8	6.3	7.2		5.8	3	6.2		33	22	24	
FINAL HARVEST - 120 DAYS												
DRYLAND												
Cherry Red	11.4	7.7	10.8	Q	15.7	11.5	13.8	NS	101	83	96	Q
Norland	15.5	15.6	14.8	NS	20.4	19.7	18.3	NS	107	117	113	NS
Nordonna	2	4.2	3.6	NS	6.2	8.5	6.6	NS	56	64	80	L
LSD 0.05	7.7	3.6	4.4		7.1	4.7	4.9		28	28	17	
IRRIGATED												
Cherry Red	56.7	48.3	39.2	L	45.1	36.7	29.5	L	187	241	251	L
Norland	70.4	56.7	56.6	L	55.6	46	40.8	L	216	220	234	NS
Nordonna	38.3	34.4	41.5	NS	41.2	34.8	38.8	NS	133	148	177	L
LSD 0.05	11.1	10.9	10.3		7.4	9.2	7.8		60	52	25	

*Linear (L) or Quadratic (Q) relationship between variable and in-row spacing (P=0.05).

1999 Results

Cherry Red produced a small, upright canopy, while the canopy for VO498-4 more closely resembled that of Pontiac. While the Norland crop had senesced by early September, the Cherry Red and VO498-4 were still growing vigorously at the time of top kill in early September.

Due to the abundant rainfall through until August, yields under irrigation were only marginally higher than those under dryland conditions (Table 2.2). VO498-4 and Norland had very comparable yield profiles in both the dryland and irrigated trials. By comparison, yields of Cherry Red were consistently poor. Increasing the plant population by reducing the in-row spacing either increased or had no effect on yields but consistently reduced the average tuber size. At the closest in-row spacing, average tuber size was still large enough to meet table standards.

Conclusion

Both NorDonna and Cherry Red are both substantially later than Norland and lack its yield potential. The market advantage provided by the superior skin color of these varieties would have to be substantial to compensate for their limited yields. V0498-4 looks comparable to or slightly earlier than Norland but may not be sufficiently superior to justify replacing the standard.

Table 2.2 Yields and tuber size distribution of three red skinned potato cultivars at 90 and 120 days after planting under irrigated and dryland conditions - 1999 trial.

	Tablestock (t/ha)				Seed (t/ha)				Avg. Tuber Wt. (g)			
	15 cm	23 cm	35 cm	L/Q	15 cm	23 cm	35 cm	L/Q	15 cm	23 cm	35 cm	L/Q
EARLY HARVEST - 90 days												
DRYLAND												
Norland	43.5	35.6	36	L/Q	48.5	40	40.5	L/Q	137	135	138	NS/NS
Cherry Red	28.1	20.4	20.3	L	33	23.6	22.2	L	123	117	136	Q
VO 498-1	40.6	38.5	40.9	NS/NS	46.8	41.2	44	NS/NS	132	148	158	L
LSD 0.05	7.3	7.1	6.5		8.4	6.8	6		9	18	18	
IRRIGATED												
Norland	48.5	44.9	45.5	NS/NS	51.4	47.4	46.9	NS/NS	143	158	167	L
Cherry Red	28.7	22.5	22	L	31.9	24	22.3	L	159	161	174	L
VO 498-1	40.6	54.2	45	Q	45.4	58.4	46.3	Q	136	170	190	L
LSD 0.05	6.1	5.4	8		5.3	6	7.2		19	38	23	
FINAL HARVEST - 120 DAYS												
DRYLAND												
Norland	44.4	43.2	34.7	NS/NS	51	47.8	37.9	L	126	134	139	L
Cherry Red	24.3	25	22.7	NS/NS	30.5	28.3	24.8	NS/NS	113	125	137	L
V0 498-1	41.1	49	40.8	NS/NS	48	53.5	44.7	NS/NS	132	161	174	L
LSD 0.05	8.3	8.9	7.1		7.6	7.4	6.6		19	18	25	
IRRIGATED												
Norland	42.1	41.8	35.6	NS/NS	46.5	44.1	38	L	137	148	152	L
Cherry Red	31.9	31.8	26.8	NS/NS	32.5	30.5	24.9	L	159	193	207	L
VO 498-1	48.9	52.7	42.8	L/Q	52.4	54.5	43.2	L/Q	156	170	191	L
LSD 0.05	6.4	7.3	6.1		6.1	8.9	6		16	34	16	

*Linear (L) or Quadratic (Q) relationship between variable and in-row spacing (P=0.05).

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Trial 3. Performance of Advanced Potato Breeding Lines

This project evaluates the most promising cultivars generated by the Agriculture Canada Potato Breeding Program at Lethbridge (Dr. D. Lynch) or by other breeders for potential licencing and/or market demand. Trials are conducted at the University of Saskatchewan and the Saskatchewan Irrigation Diversification Centre and in commercial potato fields, following standard commercial production practices. In the commercial fields, the test cultivars are grown in large blocks (rows running the length of the field). The test cultivars are compared to industry standards for; a) time of emergence and stand quality, b) incidence of disease and crop vigor, c) early yield - 90 days after planting, d) main yield - 120 days after planting. Samples are placed into commercial storages and recovered at intervals during the storage season for quality evaluation. At harvest and at intervals during storage, the crop is evaluated for; a) physical damag - bruising, shattering, skinning, shrinkage, sprouting, b) appearance - color, skin texture, c) taste and appearance following baking and boiling, sugar content and composition, and specific gravities.

Table 3.1. Comparisons between new potato cultivars and industry standards - 1998 trial.

	LONG-TERM AVERAGE		1998 RESULTS							
	Marketable Yield(cwt/a)	Specific Gravity	Marketable Yield (cwt/a)		Specific Gravity		Uniformity	Eye Depth	Skin Colour	Flesh Colour
			Early	Final	Early	Final				
RUSSETS										
Norkotah	318	1.081	302	416	1.078	1.078	Good	M	Rus	OW
FV9649-6	—	—	296	320	1.082	1.077	Good	S	Rus	OW
REDS										
Norland	338	1.072	362	458	1.071	1.067	Medium	M	Red	W
AV8081-10	—	—	336	488	1.072	1.068	Poor	M	L. Red	OW
ND 2937-3	—	—	344	434	1.07	1.07	Good	M	D. Red	OW
ND 3001-2	—	—	260	398	1.067	1.07	Medium	M	D. Red	OW
VO 498-4	—	—	320	422	1.065	1.065	Medium	M	Red	W

Eye Depth : S=Shallow, M=Medium, D=Deep

Colour: D Red=Dark red, R=Russet, W=White, Y=Yellow, L=Light

Marketable Yield/Specific Gravity: Early=90 days after planting, Late=120 days after planting

1999 Trial

Due to restricted availability of seed, the 1999 trials were only conducted on the Plant Sciences Department Potato Research plots located in Saskatoon. The trial utilized standard production practices for commercial potatoes. The crop was seeded in mid-May, in rows 1 m apart. Irrigated plots were watered once soil water potentials fell below -60kPa. Typically, 2.5 cm of water was applied at each irrigation event. The dryland plots relied solely on rainfall. Yields were evaluated at 90 and 120 days after planting. At both harvests, the crop was graded into size categories; small = < 44 mm diam., 44 < medium < 88 mm and oversize = > 88 mm diam. Table stock yields included the medium and oversize categories while the seed category included the pooled yield of small and medium size tubers.

New Cultivars tested;

ND2937-3	*is a newly released very dark red skinned variety under exclusive Canadian licence to the Saskatchewan Seed Potato Growers' Association.*
Umatilla	*a new release from the University of Idaho potato breeding program, this Russet skinned potato is believed to have superior processing and disease resistance characteristics. Demand for this variety is strong in the Pacific Northwestern United States*
Gem Russet	*a new release from the Oregon potato breeding program, this Russet skinned potato is believed to have better yields and processing characteristics than Russet Burbank. This variety is highly susceptible to mosaic virus and therefore seed must come from areas with low disease pressure.*

The 1999 growing season was cooler and wetter than normal from May through July. Little supplemental irrigation was required until mid-August. Frost killed the vines in early September, just prior to the 120 days harvest. Yields under irrigation only marginally exceed those for the dryland trials. For many of the cultivars, there was little increase in yields from the 90 through to the 120 day harvest. In the dryland trials, this could be attributed to late season moisture stress. The lack of yield increase with time in the irrigated trial was unexpected.

Norland was higher yielding than the new red variety ND2937-3, irrespective of harvest date or availability of moisture during the growing season (Table 3.2). Both of the two new russet lines were higher yielding than Russet Burbank, but not as high yielding as Russet Norkotah (Table 3.3). The average tuber size of both Umatilla and Gem Russet was small indicating excellent potential for seed growers. Specific gravities of Umatilla and Gem Russet were far higher than Russet Burbank, indicating excellent processing ability but also suggesting the potential for problems with blackspot bruising.

Table 3.2. New red-skinned potato cultivar yields, 1999.

	EARLY HARVEST - 90 DAYS				**FINAL HARVEST - 120 DAYS**			
	Table (t/a)	**Seed (t/a)**	**Avg. Tuber Wt. (g)**	**Specific Gravity**	**Table (t/a)**	**Seed (t/a)**	**Avg. Tuber Wt. (g)**	**Specific Gravity**
	DRYLAND				*DRYLAND*			
Norland	18.9	21.1	126	1.067	21.5	23.6	129	1.067
ND2937-3	11.7	16.6	82	1.072	10.2	15.3	86	1.074
LSD 0.05	**	*0*	**	*NS*	**	**	**	**
	IRRIGATED				*IRRIGATED*			
Norland	18.5	20.6	175	1.066	20	21.2	158	1.066
ND2937-3	12.3	14.7	137	1.074	14.9	19.5	100	1.071
LSD 0.05	**	**	**	*0*	**	*NS*	*0*	*NS*

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New Cultivars tested;

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Norland was higher yielding than the new red variety ND2937-3, irrespective of harvest date or availability of moisture during the growing season (Table 3.2). Both of the two new russet lines were higher yielding than Russet Burbank, but not as high yielding as Russet Norkotah (Table 3.3). The average tuber size of both Umatilla and Gem Russet was small indicating excellent potential for seed growers. Specific gravities of Umatilla and Gem Russet were far higher than Russet Burbank, indicating excellent processing ability but also suggesting the potential for problems with blackspot bruising.

Table 3.2. New red-skinned potato cultivar yields, 1999.

	EARLY HARVEST - 90 DAYS				FINAL HARVEST - 120 DAYS			
	Table (t/a)	Seed (t/a)	Avg. Tuber Wt. (g)	Specific Gravity	Table (t/a)	Seed (t/a)	Avg. Tuber Wt. (g)	Specific Gravity
	DRYLAND				*DRYLAND*			
Norland	18.9	21.1	126	1.067	21.5	23.6	129	1.067
ND2937-3	11.7	16.6	82	1.072	10.2	15.3	86	1.074
LSD 0.05	**	*0*	**	*NS*	**	**	**	**
	IRRIGATED				*IRRIGATED*			
Norland	18.5	20.6	175	1.066	20	21.2	158	1.066
ND2937-3	12.3	14.7	137	1.074	14.9	19.5	100	1.071
LSD 0.05	**	**	**	*0*	**	*NS*	*0*	*NS*

Table 3.3. Yields for russet-skinned lines in 1999.

	EARLY HARVEST - 90 DAYS				FINAL HARVEST - 120 DAYS			
	Table (t/a)	Seed (t/a)	Avg. Tuber Wt. (g)	Specific Gravity	Table (t/a)	Seed (t/a)	Avg. Tuber Wt. (g)	Specific Gravity
	DRYLAND				*DRYLAND*			
R. Burbank	10.5	15	100	1.083	11.7	15.3	123	1.088
R. Norkotah	15.6	17.7	157	1.078	18.9	19.6	188	1.078
Gem Russet	11.5	19.2	94	1.085	10.2	18.4	101	1.095
Umatilla	10.3	14.2	108	1.083	10.7	15.3	107	1.093
LSD 0.05	***3.1***	***4.4***	***13***	***0.007***	***3.6***	***NS***	***13***	***0.008***
	IRRIGATED				*IRRIGATED*			
R. Burbank	10.9	13.8	120	1.084	16.2	18.8	165	1.088
R. Norkotah	16	17.3	172	1.079	19.6	19.9	213	1.081
Gem Russet	11.7	16.7	110	1.093	17.7	21.8	152	1.093
Umatilla	11.9	16.2	114	1.087	18.6	22.2	150	1.092
LSD 0.05	***3.8***	***NS***	***16***	***0.007***	***NS***	***NS***	***12***	***0.008***

Trial 4. Plant Population Study for European Potato Cultivars

Saskatchewan is becoming a major seed potato exporter to several countries. Some countries favour European cultivars. Agronomic information for growing European potato cultivars is not available for Saskatchewan.

This study is a preliminary investigation to developing cost-effective management practices for selected European potato cultivars. This project examined the effect of seed piece spacing for several Dutch potato cultivars (Agria, Fianna, Penta) in comparison with Russet Burbank, Ranger Russet, and Shepody under irrigated production.

1999 results

Agria and Fianna produced the highest and the lowest 'seed' grade tuber yields respectively (Table 4.1). The 30 cm and 40 cm seed piece spacings produced similar 'seed' grade tuber yields. The lack of response to the spacing treatment may reflect the relatively wide spacing selected fort testing. Many of the Eupopean potato types have been selected for production at high plant population densities. Closer in row spacings should be tested in future trials.

Table 4.1. Cultivar and seed piece spacing effects on seed grade yield.

Treatment	Seed grade yield	
	t/ha	Cwt/ac
Cultivar: Agria	52.3	466.6
Fianna	34.3	306.0
Penta	45.2	403.3
Russet Burbank	43.0	383.6
Ranger Russet	40.1	357.8
Shepody	45.9	409.5
Spacing: 30cm	44.6	397.9
40 cm	42.3	377.4

Analysis of Variance	
Source:	
Spacing	ns
Rep*Spacing	ns
Variety	***(2.7)
Spacing*Variety	ns
C.V.	8.5

***, **, *, and ns indicate significance at P<0.001, 0.01, 0.05 levels of probability and not significant respectively.
Values within parenthesis are LSD (5%) estimates for the corresponding treatments.

Table 3.3. Yields for russet-skinned lines in 1999.

	EARLY HARVEST - 90 DAYS				FINAL HARVEST - 120 DAYS			
	Table (t/a)	Seed (t/a)	Avg. Tuber Wt. (g)	Specific Gravity	Table (t/a)	Seed (t/a)	Avg. Tuber Wt. (g)	Specific Gravity
	DRYLAND				*DRYLAND*			
R. Burbank	10.5	15	100	1.083	11.7	15.3	123	1.088
R. Norkotah	15.6	17.7	157	1.078	18.9	19.6	188	1.078
Gem Russet	11.5	19.2	94	1.085	10.2	18.4	101	1.095
Umatilla	10.3	14.2	108	1.083	10.7	15.3	107	1.093
LSD 0.05	***3.1***	***4.4***	***13***	***0.007***	***3.6***	***NS***	***13***	***0.008***
	IRRIGATED				*IRRIGATED*			
R. Burbank	10.9	13.8	120	1.084	16.2	18.8	165	1.088
R. Norkotah	16	17.3	172	1.079	19.6	19.9	213	1.081
Gem Russet	11.7	16.7	110	1.093	17.7	21.8	152	1.093
Umatilla	11.9	16.2	114	1.087	18.6	22.2	150	1.092
LSD 0.05	***3.8***	***NS***	***16***	***0.007***	***NS***	***NS***	***12***	***0.008***

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Values within parenthesis are LSD (5%) estimates for the corresponding treatments.

Appendix 1.

Project Personnel - 1997

Objective a:	**Celine Burns - technical assistant - full time**	**$1700/mo**
Objective b:	**Lyle Retsalff - technical assistant (part-time)**	**$ 1650/mo**
	Peter Hagel - technical assistant (part-time)	**$ 1650/mo**
	Sherri Anhwender - technical assistant (part-time)	**$ 1650 Project**

Project Personnel - 1998

Objective a:	**Celine Burns - technical assistant - full time**	**$1700/mo**
Objective b:	**Lee Michel - technical assistant (part-time)**	**$ 1650/mo**
	Peter Hagel - technical assistant (part-time)	**$ 1650/mo**
	Jennifer Hall - technical assistant (part-time)	**$ 1650/mo**

Project Personnel - 1999

Objective a:	**Greg Larson - technical assistant - full time**	**$1700/mo**
Objective b:	**Lee Michel - technical assistant (part-time)**	**$ 1650/mo**
	Peter Hagel - technical assistant (part-time)	**$ 1650/mo**
	Jennifer Hall - technical assistant (part-time)	**$ 1650/mo**

Capital Expenditures - nil

Budget to Project Completion - March 31 - 2000

Funds Allocated to the Project - $ 270,000
Award Received to Date - $246, 000
Expenditures to Date - $ 270,000
Unexpended Balance/Deficit - $ 24,000

The deficit will be covered by the final installment of this grant.

A detailed summary of expenditures will be forwarded by the Office of Research Services at the University of Saskatchewan. With the exceptions noted above, the project conformed to all budget projections and specifications.

Appendix 2.

Information Sharing

The primary collaborators (University of Saskatchewan and SIDC) have well established information dissemination programs. Key communication components for this program over the project were;

a) Plot tours -	Saskatchewan Vegetable Growers Association (July 1997, 1998 and 1999) Saskatchewan Seed Potato Growers Association (August 1997, 1998 and 1999) SIDC Annual Field days (August 1997, 1998 and 1999)
b) Presentations -	Saskatchewan Seed Potato Growers Association Annual Meeting (January 1998, January 1999 and December 1999) Saskatchewan Vegetable Growers Association Annual Meeting (Feb 1999 and March 2000) Prairie Potato Council (January 1999) Soils and Crops 1999 and 2000 Agri-Food Innovation Fund Project Review - February 2000
c) Publications	Prairie Potato Council Meeting Proceedings for 1997, 1998 and 1999 Horticulture Department - Vegetable Trial Review for 1997, 1998 and 1999 SIDC Annual Report for 1997-1998, 1998-1999 and 1999-2000

Innovation Fund Acknowledgements

AFIF funding has been verbally acknowledged in all grower tours and presentations

Project Public Information Materials

Results from this project have been published in the reports disseminated to growers and industry stakeholders across the Prairie Provinces (copies attached)

A) Horticulture Department - Vegetable Trial Review for 1998 and 1999
B) SIDC Annual Report 1998-1999. (1999-2000 version is in press)